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Oil and Gas Power

THE Oil and Gas Power Division of the American Society of Mechanical Engineers recently held its first national meeting in connection with the second annual oil power conference of the Pennsylvania State College at State College, Pa.

The Gas Power Section was the first venture of the A.S.M.E. in the direction of professional divisions. That was in December, 1907.

The large gas engine was much in evidence at that time and great dreams were built about it.

It had no place in the program of last week's meeting. All was oil.

Notwithstanding the narrowing of the field of the large reciprocating engine by the steam turbine in the meantime, the Diesel engine has made steady progress and affords a subject for an attractive range of papers and discussions.

Contrary to the usual course, its development began with engines of considerable size, and the effort has been to get more power out of a cylinder.

But there is a limit to the amount of oil that can be fired in a cylinder in a given time without burning it up.

More recently, the effort has been to produce units of smaller size capable of the sort of service rendered by the carburetor engine.

Here the difficulty is to control the quantity of oil required per stroke by a small cylinder firing many times a minute.

Improved methods of injection, spraying and mixing have resulted in notable progress in this direction, and light high-speed motors adapted to the propulsion of boats and vehicles and the operation of portable machinery are already so well developed as to warrant expectations of a large range of availability.

When it is considered what the gasoline engine has made possible and the enormous extent to which it is used, the importance of this hope of a highly efficient engine that will run upon the much lower-priced fuel is apparent.

F. R. Low

For Greater Service To Industry and Business

EXTENSION of the McGraw-Hill publishing activities to every branch of American business is the most significant effect of the merger of the A. W. Shaw Company, of Chicago, and the McGraw-Hill Publishing Company, announced in last week's *Power*.

Heretofore the magazine publishing activities of the McGraw-Hill organization have been confined to specialized service to major engineering industries and the trade channels for distributing their products. The book division of the organization, it is true, long since broadened its scope; it publishes books not only on engineering, management and industrial subjects, but on general business and scientific agriculture.

Through the merger the McGraw-Hill institution now acquires a medium by which it can speak to the whole range of American business. *The Magazine of Business* has a circulation of more than 150,000 copies and deals with the problems fundamental to all business—such as those of finance, production, distribution and sales, management, transportation and export trade. It treats, as well, those major movements in legislation which bear upon business, such as taxation, tariff and government regulation.

The importance of this new extension of the McGraw-Hill activities is apparent to all who have followed the standards which, under the leadership of James H. McGraw, have dominated its publications. To give, through effective organization, the best of which they are capable, is his constant admonition to the publishers and editors working under his direction. It presages a virile development of an already effective service to the whole business structure of America.

Further, it is significant that in referring to *The Magazine of Business*, Mr. McGraw, in his announcement of the merger, closed with these words: "It will fight for the interests of business, but it will place in an equally important position the responsibility of business to the public. It will, in a word, stand for true business statesmanship."

Past performance of McGraw-Hill papers is a warrant that this pledge will be fulfilled.

The Coal User Might Take the Tip

"WHO Will Be Next?" Thus *Coal Age* for June headed an editorial heralding the recent dramatic action of the Consolidation Coal Company in deliberately shutting down inefficient mines. The coal industry is sick—has been for a long time—and the doctors called for a major operation. Consolidation Coal has had the nerve to do something about it, and has thereby fully earned the acclaim poured upon it from sources within and without the coal industry.

But what does it all mean to the power man? What does he care if coal miners are underpaid by the year, though well paid by the day? What concern is it of his if the coal operator would do better with his capital in the savings bank? Is it not the sole concern of the coal buyer to get the best coal at the lowest prices?

Plausible, but a false doctrine. Prices lowered below the cost of production by competitive cuts leave economic sore spots that have their indirect effect on the whole body of business. Industry in general cannot afford to leave any great producing group in the dumps, because the lowered purchasing power of the group has its effect on all industry. The old adage, "One man's loss is another's gain," does not hold when that loss is caused by inefficiency. Low prices for coal are not to be sneezed at, but they must come from greater efficiency in mine operation and not from starving either miners or operators.

Consolidation Coal has taken the lead in a movement that should have far-reaching results. Everybody in the business knew that there were too many mines—many of them inefficient and lacking in modern mechanical equipment—and too many miners, but no one would do anything about it. A step has been taken that should inspire other operating companies to similar action.

Incidentally, the much lamented coal industry (at least an important section of it) has unconsciously written in the skies a lesson for the owners and operators of run-down power plants.

Inefficient, obsolete units, be they mines or power equipment, should be given a back seat. The battle is to the strong. "Who will be next?"

Coal Drying

EQUIPMENT for the preparation of powdered coal is still undergoing development and has not reached its ultimate form even today. Each new development is a step in advance of previous practice either in simplifying the layout or in lowering pulverization costs.

Coal drying before pulverization is one of the processes that has developed rapidly. The earliest central stations followed cement mill practice in the use of rotary driers for the coal. These occupied much room, required coal for heating, and did not dry some coals satisfactorily. Furthermore, these driers often created a dust nuisance.

The next step was the introduction of the waste-heat drier using flue gases as a drying agent. This drier has proved satisfactory in certain plants and many are still in use. It must be located close to the boilers and takes up much room. Its discharge often carries away much fine coal dust. The auxiliary power of the fans is a considerable item.

Steam driers were then introduced. These had the advantage that they could be placed anywhere. They functioned with certain coals, but failed to handle others satisfactorily. Furthermore, the air vent discharged much fine coal dust, which was objectionable.

Operators had observed that considerable moisture was freed in the pulverizing mill itself in addition to that carried away in the driers. This necessitated venting the system in air-swept mills to prevent condensation from the circulating air, which soon became saturated. These vents discharge fine coal dust which is a nuisance around a plant.

A later development, which is giving splendid service in many plants, is that of drying in the mill itself during pulverization. Some highly preheated air is admitted to the mill along with the air circulated by the fan in the air separation mill. This air dries the coal during pulverization and carries off the moisture. The vent from the system is carried to the primary air fan and discharged into the furnace. The system is the simplest yet developed and appears to have decreased the power required to pulverize coal in the mills.

This seems to be another illustration of the fact that the simplest devices often prove in the end to be the best and most reliable.

The Central Station Continues to Grow

THAT the progressive growth of the central-station industry continues unabated is shown by the statistical report which the National Electric Light Association has just issued. This shows an increased output for 1927 over 1926 of 9.7 per cent, the gain in domestic service being markedly greater than that for industrial power.

These data, while covering only 1,979 plants out of 3,567 for the country, nevertheless account for eighty-two per cent of the total output and represent an annual gross business of one and three-quarter billion dollars, a figure that places the central station in the front rank of American industries.

It is significant that this increase was accompanied by a decrease in the average price per kilowatt-hour, a concession made possible by further reduction in the pounds of coal per kilowatt-hour, that is, from 1.89 to 1.79. Moreover, coincident with the increased output of 9.7 per cent only 7.1 per cent capacity was added. Thus we begin to note one of the effects of interconnection that is being brought about so generally during the last few years. That three hundred small or older central stations were shut down during the year is further indication of the trend within the industry itself.

And finally, the construction budget for 1928, of which nearly a quarter of a billion will go into new power plants, indicates a continuance of that broad policy of building for the future which has contributed so much to the industry's present position.

More Sand in the Gears

OUR water powers are among the country's greatest natural resources. Even with the limited extent to which they have been developed, they supply about thirty-six per cent of the power produced by central stations. About twelve million horsepower of waterwheels has been installed. If it were commercially possible to utilize all our undeveloped water powers, they would justify an installation of over seventy million additional horsepower. For power development alone these projects would require an investment of between twelve and fifteen billion dollars. A considerable part of these resources will not be developed for a long time, if ever, but the projects that are possible of development and are now active represent an investment of billions of dollars. Yet this vast mine of potential power has been made the plaything of politics.

The Federal Water Power Act was passed by Congress in 1920 to protect the public interest in these great resources and to encourage their development under proper safeguards. To this end the Federal Power Commission was created to administer the purpose and intent of the Act. To do this intelligently involves consideration of such matters as the relation of one development to another on the same stream, the relation of power developments to other interests on a given river, and the auditing of the capital accounts for these developments, which can be done only after a thorough investigation of the claims filed by the licensees.

All this requires a vast amount of work if the interests of all parties are to be justly handled. Yet Congress has never provided the funds to employ the necessary personnel, notwithstanding the fact that the Commission turns into the United States Treasury each year funds in excess of those required for a working force to handle its work adequately. Today, the work of the Commission has fallen so far behind that it has recently issued an order that it will not consider future applications for licenses except under very restricted conditions. These restrictions threaten to prove a serious obstacle to future water-power development and add still another handicap to the many that exist.

Water power is the one natural resource that can be utilized and not be diminished by use, which is one of the best reasons for utilizing it to the economical limit. This, however, does not seem to be the intent of Congress and other legislative bodies, at least not as long as the development of these almost priceless resources can be made the toy of political expediency.

Start with the Process And Work Back

EVEN in the best engineering circles it is rare to find such wisdom as is contained in the paper, "Utilizing Low-Pressure Steam," reprinted in the last issue of *Power*. The author, Warren B. Lewis, puts common sense first and never allows technical details to befog the real issues.

Viewing the typical textile plant, he sees the importance of boiler-room efficiency, but rightly demands first attention for the enormous wastes in the use of process steam. He points out the absurdity of being satisfied with a "balance" between process steam and power when the process load balanced is far higher than it ought to be. He directs attention to the quaint attitude of those owners who pride themselves on the absence of visible exhaust steam, when millions of heat units are thrown to waste in condenser circulating water.

Mr. Lewis' program for attacking the power and heat problems may be paraphrased as follows: First, study the minimum requirements for heat, and stress the word *minimum*. Analyze every process and cut its heat demand to the bone. Second, arrange to supply these heat demands at the lowest usable pressure. Third, conserve the heat that performs no useful work. Fourth, skim from the process steam as much mechanical work as possible, up to the limit of the power usable in the plant. Go beyond this limit rather than fall short of it, because excess power from process steam involves no waste of fuel.

More straight thinking of this sort applied to plants in the textile and other industries would result in enormous fuel savings and go far to bolster up the diminishing margin between sales price and cost of production.

Brighten Up the Boiler Room

ALUMINUM paint in the boiler room may sound ridiculous to those who have not tried it, but it looks fine. One of the *Power* editors was recently in a boiler room that is wholly painted with this highly reflecting material. Everything, everywhere is painted with aluminum paint, even the floor gratings and hand rails. The result is a boiler room in which there are no dark corners. The operator says that today, without artificial light anywhere, visibility is better than it used to be with a lot of electric light that had to be kept going all day long.

Engineers have long known that aluminum paint will stand up better on hot spots. Use it for light, too. A lighter work place helps the operator to brighter thoughts.

The Rise of a New

A Southern View of the Machine Age

By Morgan D. E. Hite

THE present machine age is being put under the microscope to see what makes the wheels go around, as it were. Some inner meanings of the new era, as well as the turning of the wheels, are coming into the light. The gigantic machines that form the basis of our civilization offer us problems as significant as those which Darwin opened up with his famed thesis.

Civilization consists largely in high quantitative and qualitative increasing needs of society and the ability to fill these needs as fast as they arise. There must be a necessary volume of forced labor to support such needs. In the past the human being was everything, despite his lowly condition of servitude; all the glory of the past reminds us that we must not forget that it rested solely upon human bodies. In the machine age, on the other hand, the human tends to become increasingly less necessary, until ultimately the ideal will be to have as much machine production with as little of the intervention of the human as is possible. There are broad implications in this suggestion, too wide for the present discussion.

Slavery of some kind, human slavery or an equivalent substitute on a great and comprehensive scale, it would appear, is a necessity of civilization; without it there can be no high development or finished culture. This subject, I am aware, is usually looked on as a question in morals and is customarily expressed in terms of humanitarianism; but certain ironical facts nevertheless face us when the machine age is put under the glass, conclusions which perhaps only a Southener by descent, rearing and residence is so constituted as to bring into view. Ethical forces in this analysis appear to have a small place if any at all.

Fig. 1—Human labor in Siam rice fields

The people of highly developed states have greater needs and requirements; their wants and desires are complex and hardly delimited, as against the few needs and the minimum requirements of semi-civilized and primitive peoples. It is these requirements, ever increasing, which cause the inordinate calls for labor to supply them; and this in turn, in the absence of mechanical power, brings about the *enforced labor* of the inhabitants under the mastership of those strong enough to gain the upper hand. There has not been and cannot be any civilization worthy of the name without mass production and extensive, sustained effort. Mass production, as seen today or as in the old South, is the mark of a true slave era. This sustained production would be impossible—human nature being what it is—by voluntary labor, hence the introduction, as a necessity, of involuntary servitude.

Fig. 2—Animal power lifting

This examination of the facts makes it clear that in one shape or another an extensive slave power is the necessary groundwork of all the peoples and nations that have become great.

In the shape of enslaved man power it was the mandatory basis of the grandeur and the greatness of the ancient empires and the peoples of earth that we know of, without exception. Nearer to our own day we see that that phase of Americanism so well catalogued as "Southern," that culture and civilization and the attitude of mind peculiar to the people of the South, arose through, from

Slave Power

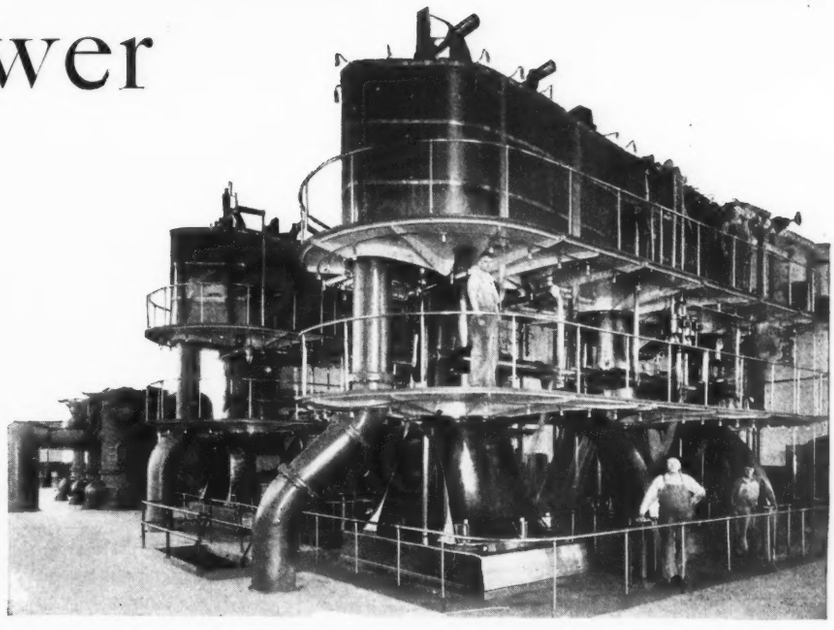


Fig. 3—Steam supplying a city with its water supply

and on slavery; and it was the men and the women of that form of civilization who completely dominated American government and policy. In other words, the once dominant power of the nation occupied its place of superiority because of its slave foundation.

Today, on the other hand, the dominant force of the nation, now non-Southern, occupies its place of superiority because of its foundation similarly on a slave basis, that *new slavery of machinery*. Machines on a grand scale now do the work of mankind in lieu of human hands and constitute the new "slave power" that gives industrialism and finance its force and in consequence the headship of the American national direction.

The one thing that unequivocally distinguishes ancient greatness from our own modern sort is the utilization by us of power machines, the substitution by us of enslaved mechanical forces for the enslaved human beings of those other times. The highest point of both eras rests on the same foundation of slavery, that is to say, labor.

water in an African desert

It is precisely because machine power had not been born into the world in past eras, that the needs of civilization which had to be supplied, were supplied by the enforced labor of men, women and children. With the introduction of steam power and its later evolution, with the amplification of steam by other means of mechanical energy, that institution of other days, human slavery—which existed only because it was the sole possible substitute for the as yet undiscovered mechanization of the world—has ceased to be. But such cessation will persist only so long as machinery serves. If all the steam and electrical power of the world and the machines were to be irreplaceably destroyed, suddenly or gradually, human slavery would of vital necessity rise again to the top. Its failure to do so would mean the race's descent to the depths of primitive savagery.

Slavery of humans could never have been suppressed and, significantly, was not, until this newer type of enslavement, of machines, had been devised and brought to the point of an assured perfection where it could take over the work of humans and thus emancipate them from an otherwise absolutely necessary servitude.

The customary preconceived opposition to slavery, common to historians and writers, on moral, humanitarian and philanthropic grounds, is an erroneous one in my view. At base such pure ethical forces are ineffective to bring about great changes in society. True revolutions are wrought only when a perfected new institution is at hand to take the place of the old less efficient institution.

Hence it was not the philanthropic motive or ethical impulse which succeeded in abolishing human slavery in this country and which has outlawed it all over the world. The force that achieved this had its fundament in the work of one man—James Watt; who, of course, little perceived what he was doing in its ultimate implications. But his motives assuredly were not ethical beyond his main purpose, which was to devise a power-machine to pump out English coal mines, that would work faster than the incoming water seepage!

Moreover, the date of the harnessing and perfecting of Nature's giant natural forces closely approximates the time of the disappearance and fading and the modifying of nearly all remaining types of enslaved human-power.

The work that steam and other forms of power are doing today in the United States alone, equals the hand-power of more than three billion men. Which is to say that civilization in America, and in European countries that exhibit a high cultural development, at present would would be restricted to a rare few only of the total population—as was the case in the old South and in all the nations of past ages. Because, in our population of 118,000,000, the ratio of human slaves necessary to serve one individual so that he could enjoy the benefits that are now common to all, would be not less than *thirty!* In short, the population of this country would be divided as thirty or more slaves to one master, which would mean about 3,800,000 masters, or freemen, and more than 114,000,000 slaves. Machines and mechanical power now perform this task, endure this servitude.

These facts converge to the special point that it is not slavery per se which is so necessary for society's growth and progress, but it is *power*, some form of harnessed giant energy. But in the absence of power of a mechani-

cal kind, there is only one possible substitute for it, namely, human muscle. Therefore, in the past, owing to the almost total absence of mechanical development of the nature of that which serves us today, particularly of steam, hydro-electric and gasoline motors, dependence of every great culture and civilization rested on human bondage. Those ancient cultures reached their apex, not despite slavery but because of it. And when they receded into the dust of the ages, slavery was the least of the contributing causes of the death of empires.

But ancient social development was at least free of the menace that threatens us; that is, a breakdown in the system which basically served society. For the very nature of human slavery, composed as it is of millions of separate and unrelated living units, is such as to preclude a universal or sudden dismemberment and dissolution. In an age of machinery and artificially created power and perilous control of it, as exists now among us, a general breakdown is possible if not probable, with consequences so disastrous that it could mean but one result to humanity —a fatal one.

Our pitiable dependence on mechanical forces is steadily rising. Individual machines are being built that will do the work of two million men; notably is this the case with some steam turbines now being produced. And again, men are become today as a new race of Centaurs, so to speak; a human body and head galloping around on four wheels motor-propelled.

Under the processes of the machine age the needs of society are developing in a geometrical ratio, as is indicated by the fact that it requires energy equivalent to the labor of more than three billions of men to meet the needs of the people of civilized America only. Our needs are so vast that the whole population of the Globe could

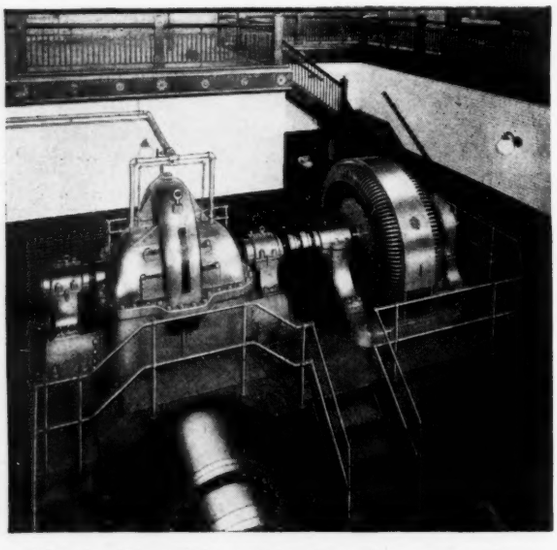


Fig. 4—Electricity as the slave in a water plant

not without machinery meet this one nation's requirements.

In the era of human servitude the master class consisted of an infinitesimal minority. This in our own time was seen again in the South just before the Civil War, when 350,000 masters controlled several million chattel negroes. At this period in our history slavery was still the only possible means of producing high quantitative and qualitative needs of a highly cultured civilization such as was the Southern. Even today there is a tremendous lack of machinery in the South; and this absence always means that there is a vast class of cheap labor at hand to take the place of machines. In the absence of machines to do the work, great supplies of such cheap negro labor is mandatory; and conversely, the latter makes machinery less necessary than in communities where hand-power is relatively scarce.

In some cases, in the South, this is because the tasks are of a kind that up to now have not been successfully adapted to machining, such as cotton picking and levee building. These are performed by hand now as they have been for more than a century. Negro labor, notoriously, is of a sort that cannot, without duress, be forced; and in consequence the South is poor because it has no authority to enforce involuntary labor in those tasks which necessarily require hands.

Where machine production is developed to a high point,

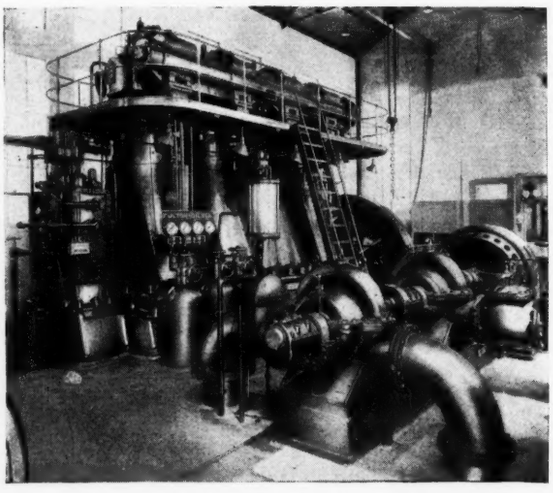


Fig. 5—Deisel power in the Los Angeles water works

there will at the same time be found a class of labor more competent and better paid. Where men are more able and produce more, as with the aid of machinery, they earn more. This runs counter to all the early notions concerning the introduction of machines. Laboring men the world over thought they would be displaced entirely. As a matter of fact, while men are being reduced to the position of adjuncts to machinery, nevertheless practically every man is needed where machines are busy, and the greatest unemployment, the cheapest wage and the most plentiful labor supply are in the regions most barren of modern machinery. The problem of mass production to match the inordinate requirements of a geometrically absorbent civilization, is not so much a problem of who will consume the goods—dependent, however, on financing the consumed—but is a question of where we will obtain sufficient men to tend the enormously increasing number of machines. Machinery to run machinery—automatic devices—is increasingly the order of the age.

The real emancipator of humanity is steam power and kindred forces. Hence a wholly new factor has been introduced into human affairs. Its true importance is not yet grasped; we are only now studying the implications of the Machine Age. The evolution of the steam engine from the time of Watt the Scottish engineer, who died in 1819, marks one of the most profound epochs, if not the most vital one, in the annals of the race. It means in its ultimate significance a complete reorganization of ideals and human relations.

The populations wherein some modern degrees of slavery persist or recently existed, suffer from under-production and poverty. Great sections of China, as in India, suffer from chronic poverty, caused largely by under-productiveness and the ills we are learning to associate with the non-mechanized regions of the earth.

In the South at the present time, some nine or ten million negroes are able to find subsistence in doing work for which no machines, or only inadequate ones, have been devised. No one has yet succeeded in applying machinery to the picking of cotton or for levee construction. Sugar cane is yet cut by hand in Louisiana. Abundant cheap labor is always a deterrent to machine progress. Australia's sugar fields on the contrary, having no abundance of labor supply, have succeeded in applying machine-cutting to this work.

It is thus, it would seem, that the mills of the gods do grind exceeding fine, and that while some men's minds, like the Scottish engineer's, are working toward some revolutionary and new thing, other men's minds, like those who felt a moral revulsion against slavery, are severally preparing the ground for the double reception by mankind of the two related ideas, namely, the introduction and rise of a new form of slavery, steam power and its corollaries. Nevertheless the mechanico-economic principle involved is the fundamental of this phase of our

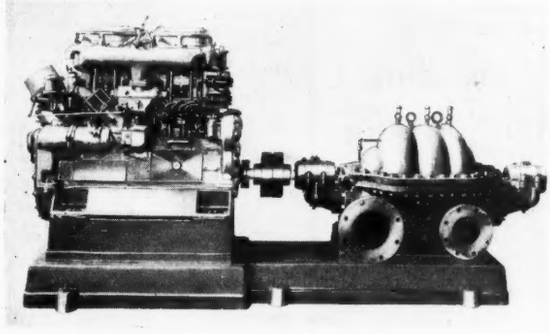
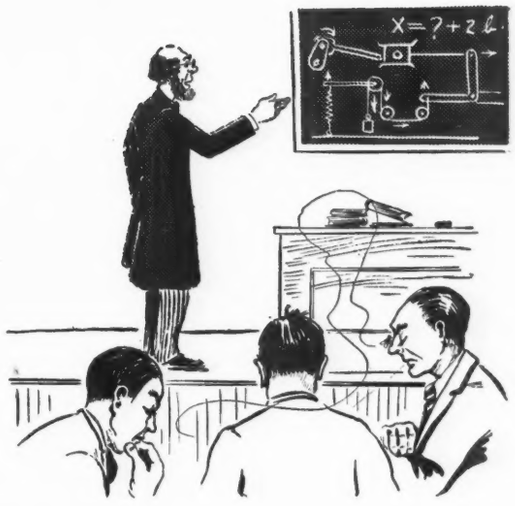


Fig. 6—Gasoline engines used as standby in a water plant

maturing race. It is possible that the moral and the purely philanthropic attitude which rises simultaneously with such great occasions is but an afterglow.

Certainly it is not pity and philanthrophy as such, which bring on revolutions so far-reaching, but something more profoundly grounded in the human race's urging toward a new and wholly different plane of progress, implying new potentials, and working subconsciously through engineer minds rather than purely ethical mentalities.



WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 55

Ques. 1—The addition of salt to water causes its melting temperatures to drop; what is the effect on the boiling temperature at atmospheric pressure?

Ques. 2—In a uniflow engine can the lead of the valves be changed by shifting the cams?

Ques. 3—Is the thermal efficiency of the hot-air engine high?

Ques. 4—In fitting up a boiler would you place a check valve between the stop valve on the feed line and the boiler?

Ques. 5—Suppose you had a tubular heat exchanger, could you increase the rate of heat transfer per square foot by stopping up some of the tubes?

Ques. 6—What is a closed feed-water heater?

Ques. 7—Why is a brick lining built inside a steel stack?

Ques. 8—In a bomb calorimeter do you obtain the lower or higher heat value of the fuel tested?

Ques. 9—What is the relative cost of a steam and a Diesel power plant in sizes between 1,000 and 5,000 horsepower?

Ques. 10—What is a common duty cycle for rating oil circuit breakers?

Why Modernize?

The old boilers are in good shape; the engines purr as sweetly as they did in the long ago. Why modernize when the old equipment is still good for years of active service? The final answer is found in the results obtained by plants that have modernized intelligently. Read in the next issue how the replacement of old equipment in a Canadian sugar refinery saved fifty tons of coal daily and reduced the labor force by sixteen men.

Why BLED STEAM

For Processing and Heating

Saves Fuel

By C. H. S. Tupholme

THE possibility of combining power and heat production economically exists in all plants that require steam for manufacturing and heating purposes in addition to power. Such plants are numerous and include paper mills, breweries, sugar refineries, chemical plants, wool-combing and weaving plants, dyeing and finishing works, briquetting plants and tanneries, to mention only a few. This category also embraces hotels, hospitals, laundries, large office and municipal buildings.

European plants of these and similar types are paying a great deal of attention to the question of effecting economies by installing a steam plant arranged for exhaust or extracted steam; and the fact that the plant may already be equipped with an economical power source does not prevent the study, for it is found that a back-pressure steam engine, operating in conjunction with such existing plant as an auxiliary producer of power affords a favorable proposition and permits a considerable reduction in working expense.

This article shows in a simple way the advantage of installing back-pressure or extraction engines in plants requiring both power and steam for manufacturing and heating processes

The steam for heating purposes and process work in the aforementioned industries is generally required at pressures varying between 5 and 40 lb. and occasionally even as high as 85 lb. In the majority of cases, however, it will be found that the steam pressures employed are much higher than is actually necessary, inasmuch as the temperature of the steam is of less importance than obtaining the required heat quantity in the heating apparatus. This quantity is equal to the difference in heat content introduced with the steam and the amount carried away in the condensate. Assuming that the condensate leaves the apparatus at a temperature of 212 deg. F., the conditions for 40 lb. and 5 lb. compare as follows:

		Pressure, Lb. Gage	Temperature, Deg. F.	Heat Content B.t.u.
		40	287.1	995.4
		5	225.2	975.2
Difference	Actual		61.9	20.2
	Per cent		21.6	2.03

This shows that although, by reducing the heating steam pressure of an installation from 40 to 5 lb., the heating temperature is reduced by about 21.6 per cent, the available heat quantity in the apparatus per lb. of steam is diminished by only 2 per cent. It is evident, therefore, that the heating capacity of the steam is barely affected by even such a big reduction in the pressure.

Let it be admitted at once that by lowering the pressure in an existing distributing system the pipes may prove too small, since the low-pressure steam will pass through at a lower speed, reducing correspondingly the amount of heat carried per hour. This defect can, however, easily be overcome by a suitable modification of the distributing system.

If, however, a certain steam temperature is essential to the manufacturing process, the pressure of the heating steam at the entry of the apparatus must be sufficiently high to insure that this temperature is available. The actual process of heating takes place at the saturation temperature and not at the superheat temperature prevailing at the inlet, the bulk of the heat being liberated as soon as condensation begins to take place.

In order to obtain the highest economy from an exhaust steam installation, it is important to keep the pressure of the heating steam as low as possible, and in planning such an installation the utmost attention must be given to this point.

Consider an industrial plant installation in which steam is produced exclusively for heating purposes in a low-pressure boiler feeding directly the heating apparatus through a distributing system. To supply the power requirements this factory is equipped with an independent Diesel engine.

On the other hand, in the plant shown in Fig. 1, the steam from the boiler passes to a back-pressure engine driving the factory equipment, and the exhaust from this engine is fed to the heating main.

Assuming that in both cases similar steam conditions in the heating main are to be obtained, it is evident that in the second plant the steam must be raised in the boiler to a higher pressure and temperature than in the first plant, since in order for the engine to perform mechanical work it is essential that a certain drop in pressure and temperature should be available.

Since this higher pressure and temperature of the steam is obtainable only by the introduction of a higher heat quantity into the process, or, in other words, by burning more fuel under the boiler, the question arises whether the gain in mechanical power justifies this extra consumption of fuel. In order to simplify this example, the pipe losses are neglected, as they do not affect a comparison of the performances of the plants.

It must be remembered that the physical properties of steam are such that to increase the pressure and temperature up to the amounts customary for driving a steam engine, only a fraction more heat is required (on the average about one-tenth) than is necessary for raising low-pressure saturated steam.

If, for example, the plant without back-pressure engine requires saturated steam at a pressure of 25 lb., an amount of 1,169 B.t.u. (inclusive of heat contained in the boiler feed) must be introduced into the boiler for each pound of steam to be raised, whereas if in the plant shown in Fig. 1 a boiler pressure of 200 lb. is decided upon and the steam is superheated 150 deg. F., this boiler would require 1,284 B.t.u. or 115 B.t.u. more per pound of steam or 9.8 per cent more fuel.

From this it follows that for raising high-pressure superheated steam, such as is required for exhaust steam utilization, very little more fuel is required as compared with an installation using low-pressure heating steam direct from the boilers.

Anyone conversant with boiler practice will at once admit that the work and cost of attending a boiler plant is independent of its pressure. When substituting a high-pressure boiler plant for a low-pressure installation, mechanical stokers are generally installed, so that in most cases the more modern plant is simpler and cheaper to operate than antiquated low-pressure boilers.

From the previous example it is seen that there are 115 B.t.u. available to the engine for converting to useful work. In the case of a small engine about 10 per cent of this heat, or 11.5 B.t.u., represents heat losses, and the remainder, 103.5 B.t.u., is converted into mechanical energy. Since 2,545 B.t.u. represents the heat equivalent of one horsepower, the steam consumption of this engine is 2,545 ÷ 103.5, or about 24.5 lb. of steam per i.hp.-hr. In other words, for even 1,000 lb. per hour of heating steam required about 41 i.hp.-hr. can be produced in a back-pressure engine. By reference to the foregoing it will be seen that this motive power, in addition to the required amount of heating steam, is obtained at the expense of only 9.8 per cent more fuel than would be necessary to raise the same amount of heating steam as low-pressure steam from boilers.

From these considerations it becomes at once evident that the larger the available heat drop in the engine the smaller will be the steam consumption and consequently the greater the power to be derived from the same quantity of steam. The available heat drop is governed by the amount of superheat and the pressure drop between inlet and exhaust.

The requirements for power and heating steam are in most plants subject to heavy fluctuations. With a plant arranged as in Fig. 1, it may be possible that, at times when the heating steam requirements exceed 1,000 lb. per hour, the power demand falls below 41 hp., during which periods a supplementary supply of heating steam direct from the boilers becomes necessary.

In an installation such as that shown in Fig 2 this is effected automatically as follows:

With increased heating steam demand and insufficient exhaust supply from the engine, the pressure in the heating main *H* tends to fall, and the automatic steam reducing valve *D* will consequently permit live steam from the main *K* to be bypassed through the reducing valve *D* into the heating main *H*. As soon as the pressure in *H* is restored to normal, the reducing valve will automatically close. A check valve prevents steam flowing back from the main *H* into the engine, and valves are installed for isolating various sections of the piping in case of need.

If, on the other hand, the factory load at times exceeds 41 hp., while the heating steam demand remains at 1,000 lb. per hr. or becomes less, the engine would supply more heating steam than could be absorbed by the heating or process apparatus. This excess of steam would have to be released to the atmosphere, which is paramount to a thermal loss and adversely affects the economy of the installation.

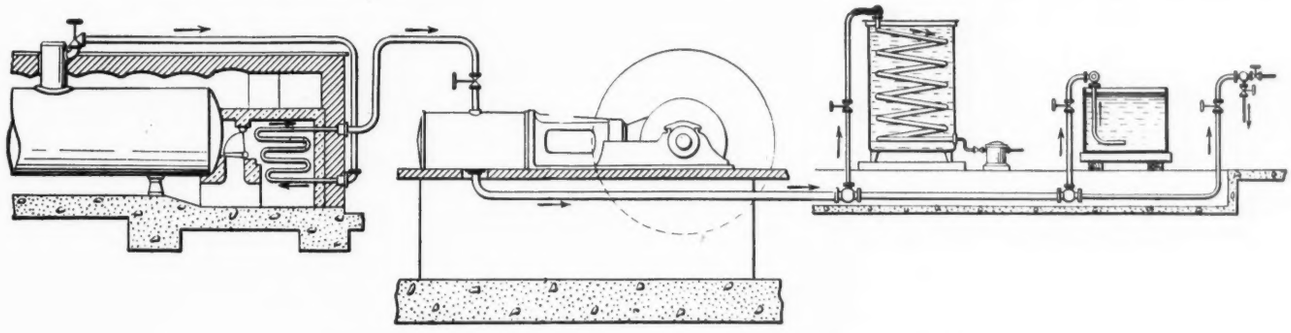


Fig. 1—Back-pressure engine exhausting to heating load

In instances where the engine supplies an excess of steam during comparatively short periods only, this steam, instead of being released to the atmosphere, can be led to a steam accumulator *A*. As soon as a pressure drop occurs in the heating system, a portion of hot water re-evaporates, and by this means it becomes possible to store heat, which in times of increased demand is liberated, the amount varying with the permissible pressure fluctuations in the system.

So far it has been assumed that the back-pressure engine, as is customary with any other prime mover, is controlled by an ordinary type speed governor in such a way that the power developed adapts itself to the output required on the engine shaft. The pressure at which the steam leaves the engine (which is to bear no relation to the output) is, as we have seen, maintained constant, being regulated by devices entirely independent of the engine, such as a reducing valve *D* and safety valve.

It is frequently possible to effect the regulation of a back-pressure engine in a different manner; that is, by adapting its output no longer to the power required on the shaft, but to the heating steam demand. With this method of governing, the engine valve gear, instead of being controlled by a speed governor, is put under the control of a back-pressure steam regulator. This method, however, can be applied only to cases where another power source equipped with speed governor, such as a

second steam engine, Diesel or water turbine is mechanically (or electrically) coupled to the back-pressure engine. Non-compliance with this condition would have the effect that, with a reduced heating steam demand, the output of the engine would no longer correspond to the power required on the common shaft (with electric drive, on the busbar) thus causing the speed of the shaft to fall, which is not as a rule permissible. If, however, the whole system, as previously mentioned, is connected with an auxiliary power source, the tendency to a fall in speed on the shaft causes the speed governor of the auxiliary engine to regulate for an increase in its output, whereby the speed is restored to normal.

Economy of Back-Pressure Engine

The use of a back-pressure engine in conjunction with another power source represents the most economical method of obtaining mechanical power from steam primarily developed for heating purposes. As a particularly interesting application, the operation of a back-pressure engine in conection with an electric power supply system may be mentioned. It is well known that a large number of hydro-electric power stations suffer from having to carry heavy overloads during the cold period of the year, which is precisely at the time when rivers and mountain streams have little water and when the demand for current by the consumers reaches the highest peaks. A great number of the latter are compelled to raise considerable quantities of steam for heating purposes in winter, which, as has been shown, can also be combined with power production at a negligible extra cost.

By the suitable application of the steam engine along the lines described, consumers have in their hands the possibility of reducing the strain on the hydro-electric stations during the winter. In the summer, when the available hydraulic energy is greatest and the steam requirements of the consumers is lowest, the latter can

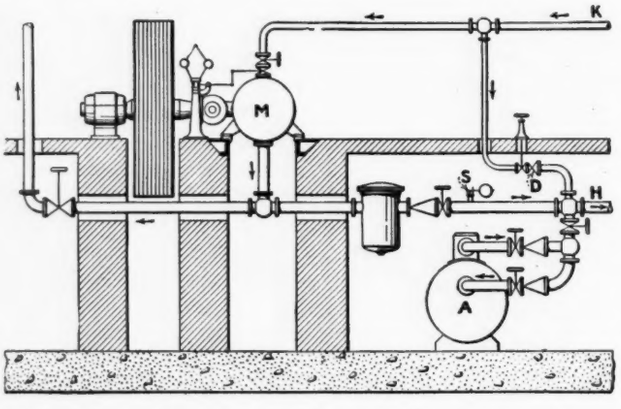


Fig. 2—Back-pressure engine and heat accumulator

then with advantage draw from the surplus energy from the hydro-electric station and relieve the steam plant.

In works in which no economical auxiliary power unit can be installed and in which the power demand is generally so great that the amount of steam required for this purpose is in excess of what is required for process or heating work, the substitution of engines arranged for intermediate steam extraction in place of back-pressure engines is the proper course to adopt.

A great feature of this type of prime mover is its adaptability to the most varying service conditions. At times of maximum heating demand, only a sufficient minimum of steam is passed into the low-pressure cylinder to prevent it from running dry. In this case, therefore, the high-pressure cylinder deals with practically the whole load, so that the engine runs as a back-pressure engine as already described.

If, however, no heating steam is required, the whole of the steam is made to pass from the high-pressure through the low-pressure cylinder to the condenser, and

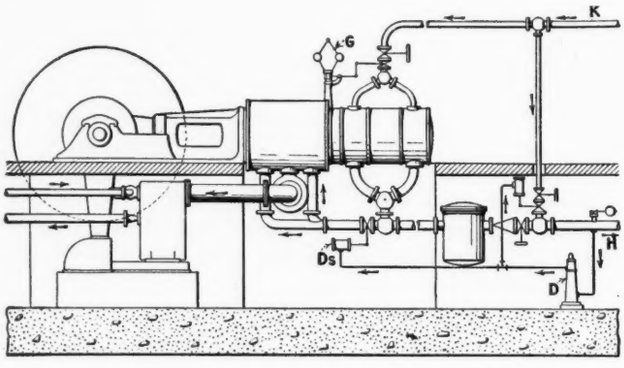


Fig. 3—Extraction engine serving heating load

the engine runs in the same way and just as economically as an ordinary tandem-compound condensing engine.

In a pure back-pressure engine it is possible, as has been shown, to regulate either the output or the steam quantity. In an extraction engine, on the other hand, it is possible within very wide limits to regulate automatically both the output, to suit power requirements, and the steam quantity passing through the high-pressure cylinder, to suit the heating steam demand.

For this purpose the valve gear and therefore also the output of each cylinder is influenced by its own governor, the one regulating the high-pressure cylinder being an ordinary speed type governor G, and that regulating the low-pressure cylinder being a pressure regulator, D, D_s, both shown in Fig. 3.

If a prevailing state of equilibrium on the engine is disturbed for any reason, the following takes place: An increase in the heating steam demand with the load remaining constant, tends to reduce the pressure in the main H, as a result of which the pressure regulator D, D_s, which is connected with H through a small steam pipe, curtails the steam admission to the low-pressure cylinder. By this operation the bulk of the increased heating steam demand is provided for. The reduced steam admission to the low-pressure cylinder now causes a reduction in the output and a retardation of the engine speed. This is counteracted by the speed governor G, which increases automatically the high-pressure cut-off to such an extent that not only is the pressure in pipe H re-established, but also the speed of the engine is restored to normal, and the combined output of the low-pressure and high-pressure cylinders amounts exactly to the same figure as prevailed at the beginning of the regulating process.

Unfortunately, with an extraction engine the steam conditions become somewhat too involved to demonstrate the economy in a manner equally simple to that shown for the pure back-pressure engine, but the diagram, Fig. 4, gives a fair idea of the utilization of the heat in this type of engine. The total hourly steam quantity D introduced may be considered as subdivided into two parts,

one of which, D_1, represents the amount extracted per hour from the receiver. The power developed in the high-pressure cylinder corresponds to an amount in heat W_{v1}, which on an average is about 10 per cent of the heat quantity introduced into the engine.

The second part D_{1v} of the total amount of steam D admitted, is that which is not extracted but passes from the high-pressure into the low-pressure cylinder and is condensed after having performed mechanical work in both cylinders. The amount of heat W_{v111} thus con-

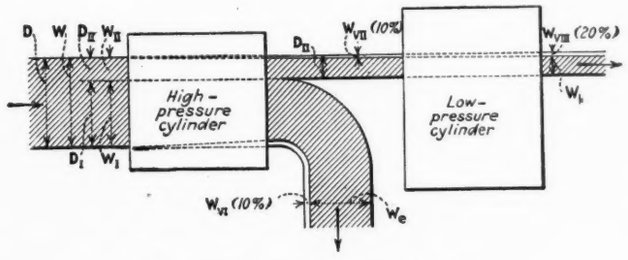


Fig. 4—Heat balance diagram

verted into mechanical work is comparatively small, on an average about 20 per cent of W_{v11}, and the amount of heat lost in the condenser W_k comparatively large. It is therefore evident that the thermal efficiency of the engine will increase, the greater the amount of steam extracted, until finally, when the minimum of steam is passing into the low-pressure cylinder and condenser, the economy of the back-pressure engine is approached.

To arrive at the steam consumption per brake horsepower-hour we have to deal first with the steam quantity D_{11} and further with a steam quantity which, while being raised to the admission pressure and temperature, would absorb the equivalent of the heat W_{v1} used up in the high-pressure cylinder for power production. These two quantities represent with a reasonably large extraction a very low steam consumption. That portion of the steam quantity D which supplies the heat quantity W_e of the extracted steam quantity, must of course not be booked to the account of power production and is therefore not to be considered when estimating the specific steam consumption.

For regulating the output of a back-pressure engine or the low-pressure cylinder of an extraction engine to suit the heating steam requirements of an industrial plant, it is essential to have a regulator that is at the same time highly sensitive and powerful. These conditions are admirably fulfilled by the Sulzer oil-operated pressure regulator, which has been adopted on a large number of European plants.

ANSWERS to "What Do You Know"

The questions are on page 51

Ans. 1—The addition of salt lowers the vapor pressure, so that to boil at atmospheric pressure the temperature must rise above 212 deg. F.

Ans. 2—No. The lead can be changed only by shifting the eccentric.

Ans. 3—A thermal efficiency of 20 per cent is possible, but the mechanical efficiency is so low, owing to the size of the parts for a given output, that the brake efficiency is low.

Ans. 4—No. According to the A.S.M.E. Boiler Code the stop valve should be between check valve and boiler.

Ans. 5—Yes. The rate increases faster than the increase in gas velocity.

Ans. 6—A closed feed-water heater is one in which the exhaust steam is introduced in a compartment or series of compartments separate from the compartments occupied by the feed water.

Ans. 7—The brick lining is a protection for the steel against corrosive acids in the chimney gases.

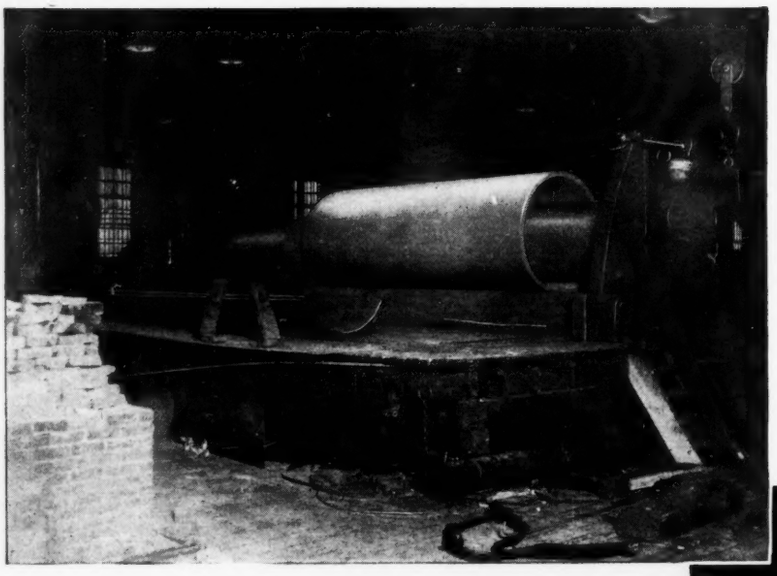
Ans. 8—If a few drops of water be placed in the bomb to insure a saturated atmosphere, the heat resulting from combustion of the hydrogen content of the fuel will be included in the heat value found, consequently the bomb will give the "higher heat value."

Ans. 9—If the steam plant is completely equipped with up-to-date machinery, the cost difference is slight, and frequently the Diesel plant costs are the lower.

Ans. 10—The standard duty cycle on which the rating of oil circuit breakers is based, consists of the two-unit cycles at a two-minute interval. Starting with the breaker in the open position, it is closed and then opens on near its rated capacity, and after two minutes it is closed again, after which it opens on near its rated capacity. The rules require that the breaker be then inspected. This is known as the 2-OCO duty-cycle combination. This cycle may be modified to meet operating conditions.

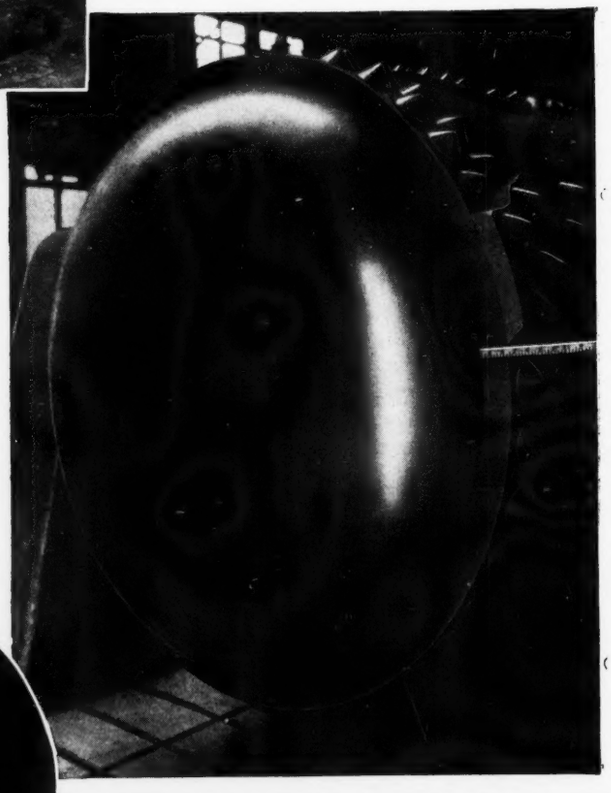
It's in Paris

French engineering, like French art, generally runs to the fine and delicate. Size is supposed to be an American specialty. Yet there is nothing picayune about a 19,400 sq.ft. boiler built to deliver steam at 615 lb. pressure and 824 deg. F. This boiler (to be described in the next issue) is fired with pulverized fuel. The drums were forged from solid steel billets at the famous Schneider works in Greuset. And the steam produced will drive the turbines which furnish the current that turns night into day on the magnificent Boulevards of gay Paree.

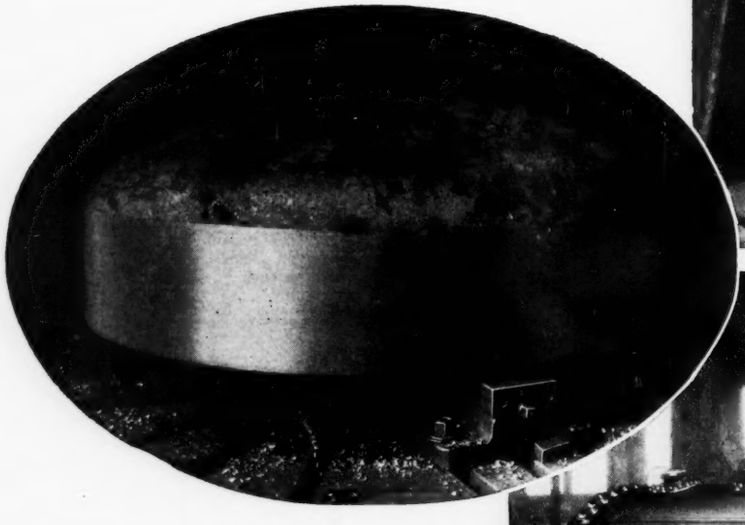


The $2\frac{1}{4}$-in. plate is hot rolled to form the drums of a 5,600-sq.ft. 460-lb. boiler

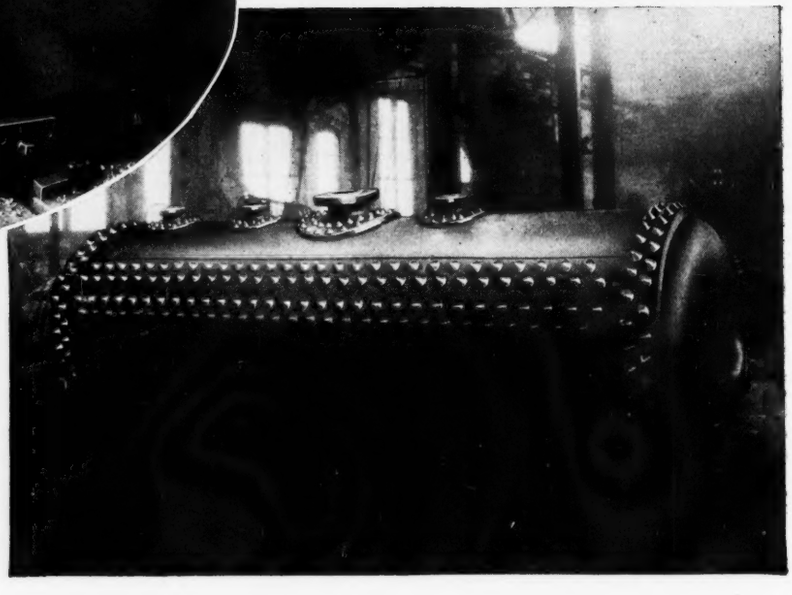
The shell and head after riveting



How a High-Pressure Boiler Is Made



Above—The heads are machine turned on the outside to fit the shell



Right—The completed drum with nozzles attached

Photos obtained through courtesy Erie City Iron Works Company

The Return-Tubular Boiler Is Defended

By F. W. Dean
Consulting Engineer, Boston, Mass.

THE reappearance of horizontal tubular boilers as a subject of engineering discussions shows that they are of interest to boiler users, notwithstanding the tendency of the younger men to think that they are out of date and do not possess the qualities that good boilers should.

This design of boiler is not well understood by many, and it is common to hear people speak as if they could accomplish much more in economy and power with water-tube boilers. This idea comes, I think, from the immense amount of propaganda put forth by the makers of water-tube boilers and from the reports of the performance of large boilers in central stations where there are many ways of keeping the boilers up to concert pitch. In many such places the boilers are forced to

Of course the limitations of this type of boiler are size and pressure, but there is no reason why 102-in. boilers should not be built, and they can be made with nearly 6,000 sq.ft. of heating surface for pressures up to 200 lb. They have been built 96 and 108 in. in diameter, and, I have been told, 120 in. I know of no reason why they cannot be. A 102-in. boiler for 200 lb. would require 1-in. plates. There are quite a number of 90-in. boilers with plates $\frac{3}{32}$ in. thick and one having $\frac{5}{16}$ in. These thick plates behave in no respect differently from thin ones, and this is in accordance with the theory of the transmission of heat through plates of different thicknesses.

It will be found that gases pass out of horizontal return-tubular boilers a little hotter than from the water-

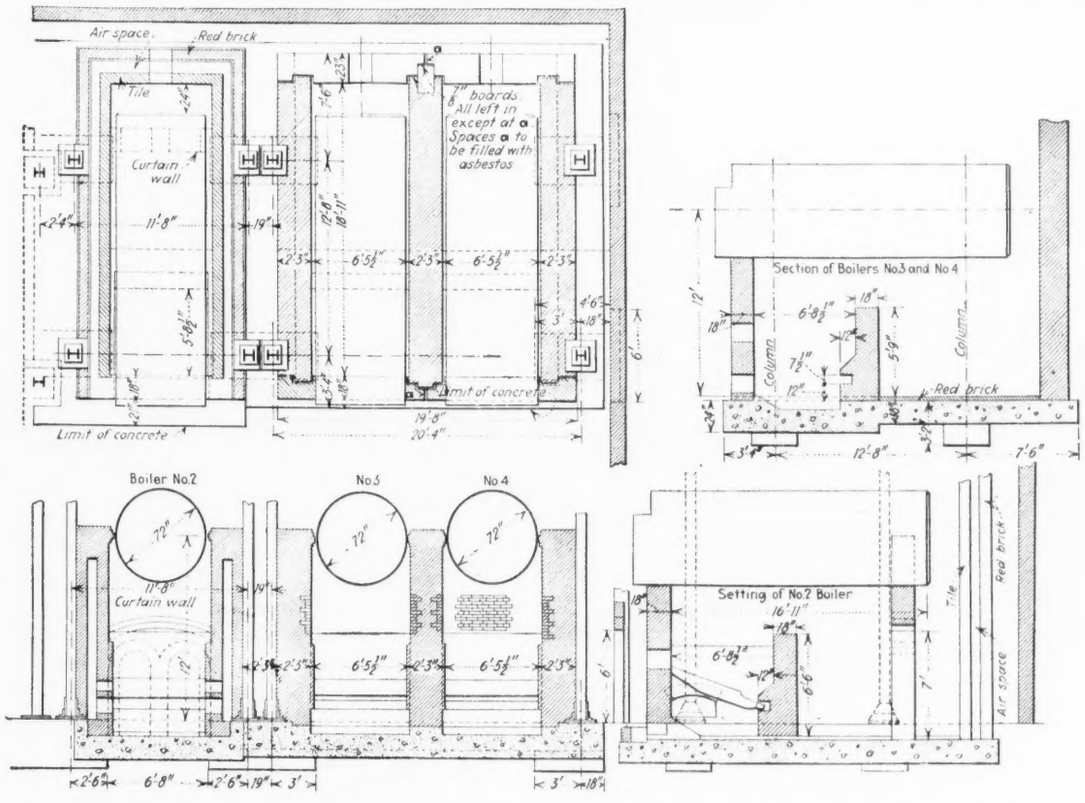


Fig. 1—Various types of boiler settings; one has hollow walls and two are provided with asbestos-packed expansion joints

300 per cent of rating and occasionally more, and the impression is given that horizontal return-tubular boilers cannot be so forced. Actually they can be, and in some cases they are. They are often located where forcing is unnecessary, but they are probably often forced without its being known, and in paper mills forcing seems to be the rule.

tube type because air leaks through clean-out and access openings, with which the latter are provided, and cools them.

But I know of 90-in. boilers with 260 three-inch tubes 20 ft. long that, when operated at slightly more than 150 per cent, give a gas temperature of 510 deg. Another 90-in. boiler having the same number of 3-in. tubes

17 ft. long, gives a gas temperature of about 560 deg. when operated at 175 to 200 per cent.

Low gas temperatures are suspicious, as they usually are due to air leaks. Internally fired boilers, such as the locomotive, Scotch and vertical types, give high gas temperatures, because, unless there are smokebox leaks, air cannot leak in to cool them. In such cases, however, the air that leaks in does not pass through the boiler and only diminishes the draft and chimney capacity. If economizers are used, their effect is reduced by these leaks. Notwithstanding all this, makers of vertical boilers continue to cover the smokeboxes of Manning and other vertical boilers with covers of loose-fitting sections that leak air to such an extent that the gas temperature is often lower than that of the steam.

Tube Length and Spacing

Tube lengths of 24 ft. can be used, for there are many locomotives with $2\frac{1}{4}$-in. tubes of this length. Tubes only $\frac{3}{4}$ in. apart can be safely used, as there are many horizontal boilers with this spacing, and no locomotive has it greater, and some only $\frac{5}{8}$ inch.

I regret that the butt joint in boilers seems to be standardized as one with a narrow outside and a wide inside strap, as if this were the final solution of the butt-joint problem. Butt joints are used in order to have something better and safer than lap joints, but the joint with narrow and wide straps is still a partial lap joint and it bends at the edges of the narrow strap when the boiler is subjected to pressure and bends back when the pressure is reduced. A number of them have cracked, but, fortunately, the cracks have been discovered before rupture occurred. Some time there will be an explosion of a

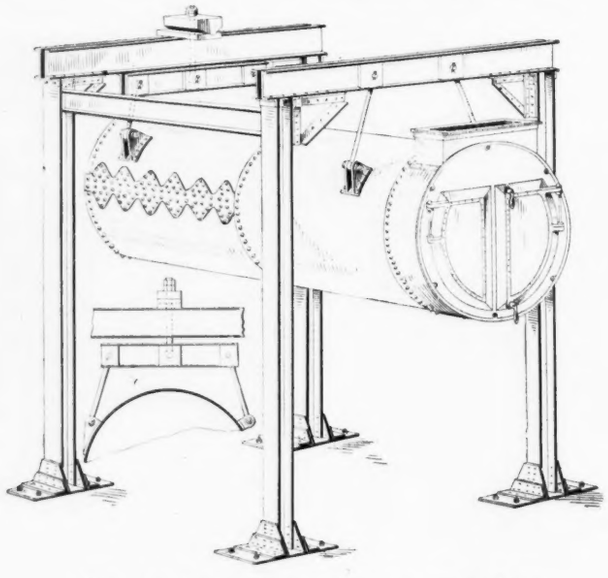


Fig. 2—The author's favorite suspension

boiler with this one-sided joint. Butt joints should have the straps of equal widths in order to prevent bending with variation of pressure.

Butt joints can be made with straps having three rows of rivets each side of the center, the outer pitch being double the inner and the efficiency about 86 per cent. In designing a boiler when it is not of great importance to go to extremes in economy of plate, it is best to use this joint, because the narrower a joint is, the better, as the inside strap is a bent tie and tends to straighten out between the rivets. The narrower the strap is, the less this occurs. This is a good reason for making inside straps very thick.

When a higher joint efficiency is desired, the straps must be wider and the outer rivets farther apart and, finally, so widely spaced that the straps cannot be calked. In this case the outside strap should be of the saw-tooth form, as shown in Fig. 2, to bring the edge near enough to the rivets to be calked. When a sample of such a joint is pulled in a testing machine, it does not bend,

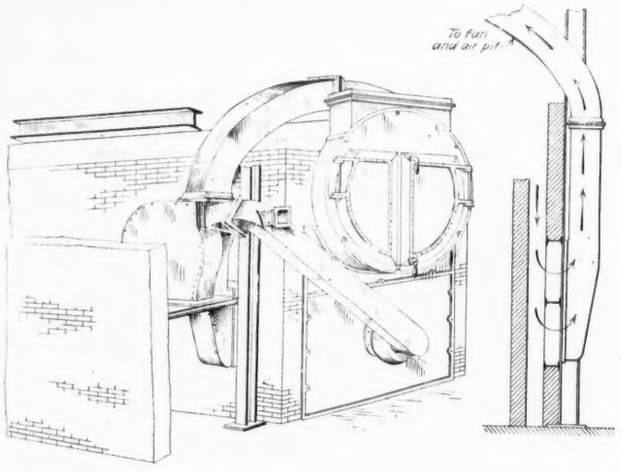


Fig. 3—A method of taking preheated air from the hollow brick walls

while the one-sided joint does. Bending, not only in joints but in bracing, if often repeated, as it is in boilers, causes rupture.

Three-Point Overhead Suspension

Overhead suspension is advisable in any size of horizontal return-tubular boiler, and it should be of the three-point design, as shown in Fig. 2. The advantage of this feature is that the supporting rods hold up the intended weights and no settlement or readjustment can change it. With any other means of support a boiler is supported, practically, at three points, because it is impossible to adjust them so that they will take equal weights, and nobody can tell how much each support holds. The least settlement or motion of any of the parts renders one support useless, and it is not very satisfying to the imagination to contemplate a boiler being supported at two points on one side and one on the other. The addition of springs still leaves the matter in the dark. A three-legged stool will rest firmly on an irregular floor.

Another commonly used defective feature of supporting horizontal return-tubular boilers is U-bolts, the lower part passing through a bracket riveted to the shell and the upper straddling a steel beam, then passing through a bar and having a nut or nuts above on each leg. A single rod should always be used at each point.

The columns that support the overhead beams should be of the Bethlehem type with one flange of each in contact with the bricks. They thus act as buckstays and should never be set into recesses in the setting walls, because recesses weaken walls and start cracks.

With regard to diagonal braces between the columns on each side of a setting, they are correct enough, but for some years I have not used them. I employ instead a horizontal 12-in. I-beam between the columns near the top, as shown in Fig. 2. It is secured to the columns by angles on each side of the web and both flanges of the

beam, the angles being riveted to the beam and bolted to the columns. Experience shows this to be sufficient. Beams hold the columns together crosswise of the setting, and there is no reason why they should not hold them the other way.

The tendency to set horizontal return-tubular boilers very high is, I believe, a mistake. It is supposed to promote economy, but the performance of the Emergency Fleet Scotch boiler shows that it does not, as in that boiler the flue gas had 15 per cent CO_2 after a travel of from two feet to four feet from the back of the bridge wall, and the combustible gas was reduced to zero. In hand firing with coal the efficiency reached 80 per cent and with oil, 84.5 per cent.

Scotch Boiler Has Lowest Temperature

The idea prevails that combustion cannot occur without very high temperatures, but in the Scotch boiler the temperature is probably the lowest of all boilers. It has small firebox volume, small volume beyond, and all surfaces within which combustion occurs are near the fire and comparatively cool, as they are in contact with water. It thus violates all the theories that are commonly held.

It is important that the combustible gases should mingle with all the air, and this is much less likely to occur in a high furnace than in a low one, and less surplus air is needed to bring it about in a small furnace, with resulting better economy. In a Scotch boiler the gases and air are necessarily in intimate contact.

In a high-set horizontal return-tubular boiler the bridge wall should be high in order to have at least one small area for the combustible gases and air to be in close association.

Not more than two boilers should be set together. If there are many boilers the mid-wall of a pair should be omitted, thus converting two boilers into one and reducing brickwork. The space between them can best be covered with a suspended arch, and this, by the way, seems to be the best way to cover the back connection of such boilers. A pair of boilers thus unified will cover about the same floor area as a water-tube boiler of the same power, and usually will be of less height. There are several pairs of 90-in. boilers in operation, which are constantly worked at 300 per cent rating with an efficiency of over 80 per cent.

Air-Cooled Brick Setting

A recent form of brick setting is the air-cooled type. It consists of an inner wall of fire tiles and an outer one of red brick or other insulated material some eight inches away from the inner. Air passes between these walls, removes heat from the inner and cools it materially. It stands pulverized coal remarkably well. In the case of hand-fired boilers the hot air should pass to the ashpit through an opening in the tile wall on each side, and the boiler operated with closed ashpit doors, as indicated in Fig. 3.

In the case of stokers the hot air should be blown through the tuyeres, and in the case of pulverized coal into the pulverizer and burner. In the latter case it is best to have the back wall of the boiler bricked off from the sides and to have in addition a cellular furnace bottom through which the air from the back wall passes. This air is taken by the pulverizer fan, and air from the discharge duct of the side-wall fan discharges chiefly into the burner and through a small branch duct into the fuel intake of the pulverizer. The moisture in the coal is thus somewhat dried and combustion promoted.

I advocate placing the blowoff pipes of horizontal return-tubular boilers at the front end because it requires no protection, and thus a long-standing trouble is cured. I cannot imagine any objection to front-end blowoffs, but it should not be thought that blowing off a boiler will keep it clean, whether it is done at one end or the other. Cleanliness is next to Godliness in boilers as well as in human beings, and boilers should be opened often enough to keep them clean. Almost all boiler troubles come from dirt, and yet in many installations dirt is allowed to accumulate until trouble occurs.

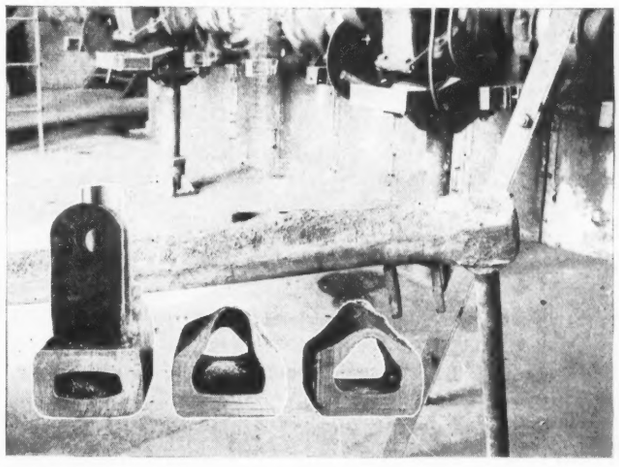
I have frequently taken it upon myself to champion the cause of horizontal return-tubular and other fire-tube boilers, but here I will only call attention to one feature of the action of hot gases as they pass through fire tubes. The skin friction on the tubes holds back the outer part of the gas and causes the center to reach the outside. The gas is thus constantly being turned inside out throughout the length of the tubes. It is difficult to imagine a more effective way of removing the heat from hot gas.

Why the Superheater Tube Failed

By R. G. Edwards

SOME time ago we had occasion to replace one of the elements of a radiant-type superheater. The cause of the damage was most apparent and at the same time unlooked for.

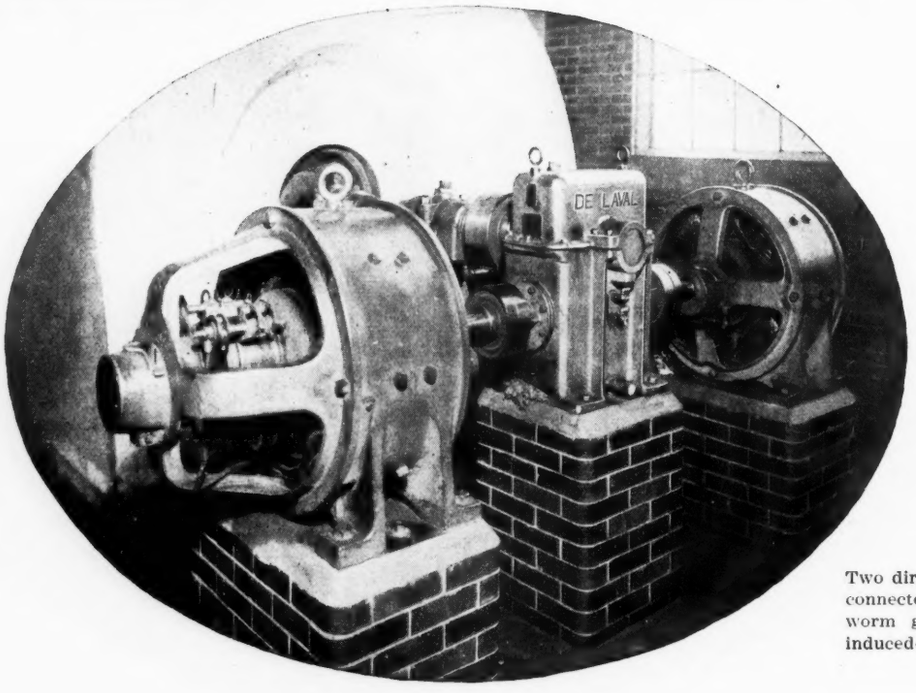
The superheater forms one of the side walls of a stoker-fired furnace, which is a part of the setting of a cross-drum boiler. We had operated the unit for almost a year before the element showed signs of failure. This absence of trouble was probably due to the fact that we had operated at comparatively low ratings, for it took only a few weeks of operation at higher rating to cause the tube to bulge and fail.



The tube that failed

The accompanying illustration tells the story, and it is only necessary to add that the obstruction was a piece of refractory material, probably plastic brick, that found its way into the tube during the construction period. It was firmly wedged into the element close to the inlet nipple, the rupture occurring at the opposite end.

The illustration shows the bulge on the top of the element, while the three sections show the condition of the tube interior.



Two direct-current motors connected through a worm gear to an induced-draft fan.

SLOW-SPEED *Versus* HIGH-SPEED MOTORS

By B. A. Briggs

A comparison is made of the power factor, efficiency, cost, starting torque, starting equipment and maintenance of slow-speed motors directly connected to the load with high-speed motors connected by a speed reducer.

MOTORS may be connected to their loads either directly or through some form of speed reducer. So much stress has been laid on direct connection during recent years that many plant operators are inclined to accept this as the most desirable means. Such an assumption may be far from good engineering practice. There are certain classes of equipment that have an economical speed that corresponds closely with that of medium- and high-speed motors of the correct rating for their drives. In this field direct-connecting the motor to the load generally gives the best arrangement.

Outside the legitimate application for direct drive there is a large field where a speed reducer between the motor and its load gives the most desirable arrangement. In fact, there are many applications where a speed reducer is necessary, since it would be practically impossible to build motors for the low speeds required for direct connection. With alternating-current motors there is also the difficulty of matching the speed of the motors with that of the driven machine.

The table shows the synchronous speeds of 25- and 60-cycle motors. These speeds are correct for the synchronous type, but the general-service induction type will operate about 3 to 5 per cent below the values given in the table. For the 25-cycle type the maximum speed is 1,500 r.p.m. and for 60 cycles 3,600 r.p.m. is the maximum speed.

Take a case where it is desired to operate the driveshaft of a machine at 2,700 r.p.m. If this is to be done by a 25-cycle motor, then a speed increaser will have to be used between the motor and its load. If 60-cycle current is the source of power, there is the choice of a 3,600-r.p.m. motor with a speed reducer or an 1,800-r.p.m. motor with a speed increaser. The other choice is to design the machine for one of the standard motor speeds. This may be objectionable on account of the effect it may have on the efficiency and other characteristics of the machine.

Where the speed of the machine is slow, the motor's speed for direct connection must also be slow. With direct-current motors the chief objection to slow speed is the high cost and low efficiency. When alternating-current motors are applied, the slow-speed induction type has the additional bad feature of a low power factor.

Electrical Applications

The curves shown in Fig. 2 are for a line of 15-hp. squirrel-cage induction motors ranging in speed from 450 to 3,600 r.p.m. The 3,600-r.p.m. motor has a power factor at full load of about 0.92 and at one-half load about 0.84. As the speed of the motor is decreased, the power factor decreases. The 450-r.p.m. motor at full load has a power factor of only about 0.66, and at half load the power factor is less than 0.40. Between full-load and one-half load the power factor of the 3,600-r.p.m. motor decreased less than 10 points, and on the 450-r.p.m. motor the power factor decreased about 25 points.

In many applications the one-half-load power factors are of more importance than the full-load values. It is at the lower values of load that many motors operate for part or all of the time. For this reason the slow-speed

SYNCHRONOUS SPEEDS OF ALTERNATING-CURRENT MOTORS

No. of Poles	R.P.M. 25-Cycle Class	R.P.M. 60-Cycle Class
2	1,500	3,600
4	750	1,800
6	500	1,200
8	375	900
10	300	720
12	250	600
14	214.3	514.3
16	187.5	450
18	166.7	400
20	150	360

motor is at a decided disadvantage. The 3,600-r.p.m. motor, when operating at one-half load, would have a power factor of over 0.80, a value that would be considered fairly good. On the same load the power factor of around 0.40 for the slow-speed motor could scarcely be justified on any system. When power is purchased, a penalty for low power factor may be included in the rate, which will make the low-speed motor an undesirable load for power-cost reasons.

When the efficiency of the slow-speed motor is compared with that of the high-speed machine, it will be found that the slow-speed motor may be five or seven points lower. Fig. 5 shows the full-load and the half-load efficiencies of a line of 15-hp. squirrel-cage motors. These curves indicate that where an 1,800-r.p.m. motor may have a full-load efficiency of 90 per cent, the 450-r.p.m. motor's efficiency is about 82 per cent. A good speed reducer will have an efficiency of 97 or 98 per cent. When this is included in the efficiency of the high-speed motor, the power saving in favor of the high-speed machine may be sufficient to pay for the speed reducer in a year or less. Of course the saving in any case depends

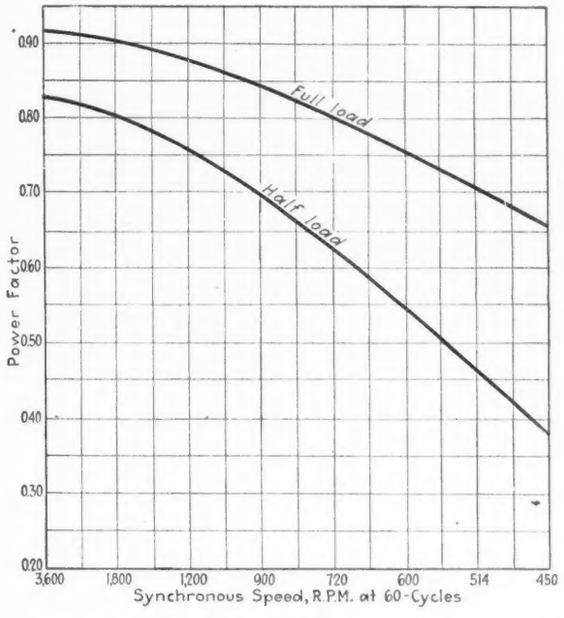


Fig. 2—Curves showing power factors of 60-cycle 15-hp. squirrel-cage induction motors at different speeds

upon the difference in speed of the two motors compared, the cost of power, the number of hours operation per year, etc.

The cost of motors varies almost inversely as their speed. For example, the cost of an 1,800-r.p.m. 15-hp. squirrel-cage motor will be around $130. A motor of this size for 450 r.p.m. would cost about $400. The difference, $270, is more than twice the cost of any type of speed reducer available. Many of them will cost only

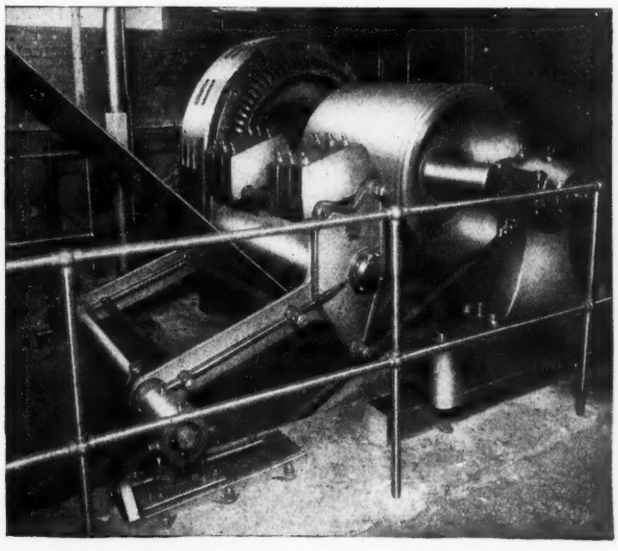


Fig. 1—Alternating-current motor rated at 500 hp. connected to compressor by Lenix drive

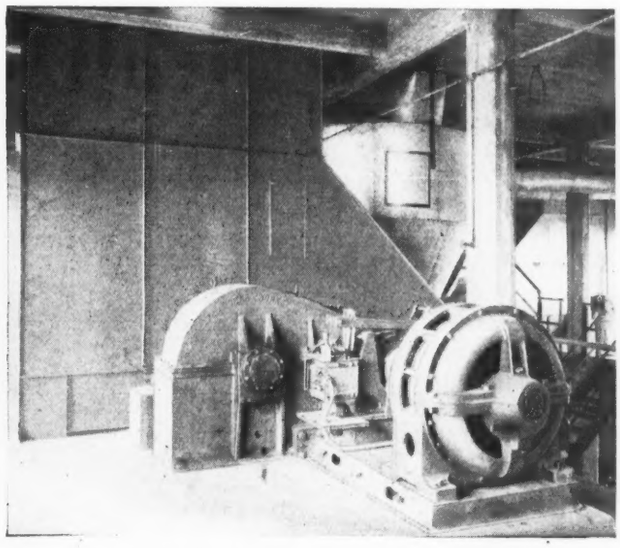


Fig. 3—Squirrel-cage motor rated at 125 hp. geared to receiving leg of a grain elevator

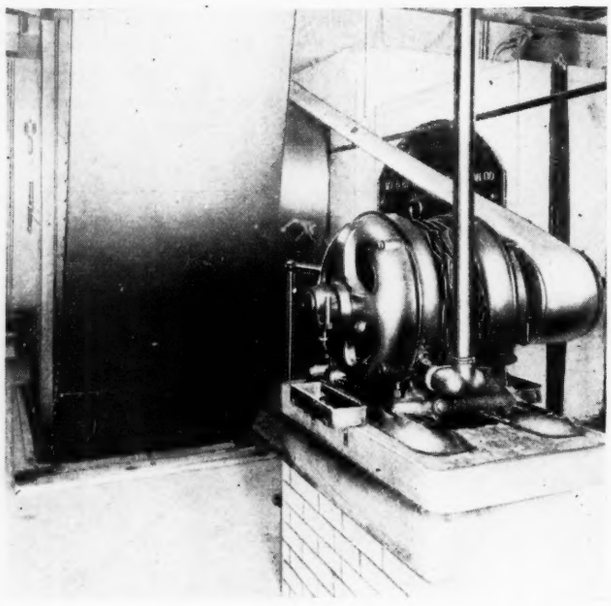


Fig. 4—Exhaust fan driven through a belt from a squirrel-cage induction motor

about 25 per cent of this. Therefore, from the point of cost the high-speed motor with a speed reducer has an advantage over the slow-speed machine directly connected to its load. This advantage will vary with the size of the motors and difference in speed between the high- and low-speed machines.

With the low-speed machine the maximum inrush current at starting is lower than for a high-speed motor of equal capacity. In this respect the slow-speed motor has an advantage over the high-speed machine. This feature, however, is not generally a deciding factor.

Starting Torque Applied to Load

The starting torque applied to the load by the high-speed motor through a reducing gear will be considerably higher than for the slow-speed motor directly connected. As an example, in one line of squirrel-cage motors a 15-hp. 1,800-r.p.m. motor connected to its load through a 3 to 1 speed reducer develops about 250-ft.-lb. torque on the driveshaft of the load. A 600-r.p.m. motor of the same capacity will develop a maximum torque of 160 ft.-lb. Therefore, so far as starting ability is a factor the high-speed motor with a speed reducer is superior to a slow-speed motor directly connected. To what extent this is an advantage will depend upon the character of the load, the starting torque required and other conditions. Where reduced-voltage starting is used, the better torque characteristics of the high-speed motor may allow starting with a lower inrush current than required by the slow-speed motor.

The maximum inrush current of the 1,800-r.p.m. motor under discussion at 440 volts is about 141 amperes. This motor, then, will develop a torque per ampere at its load of 250 ÷ 141 = 1.77 ft.-lb. For the 600-r.p.m. motor the inrush current is 120 amperes and the torque per ampere is 160 ÷ 120 = 1.33 ft.-lb. The higher torque per ampere inrush for the high-speed motor is a decided advantage in favor of this motor if it is to be started on reduced voltage. This feature will allow starting with a lower inrush current than for the slow-speed motor. When starting is by connecting the motors across the line, the high-speed motor may be at a disadvantage, as its higher torque may be excessive for the machinery being started.

In the application of synchronous motors conditions vary considerably from those governing the use of induction motors. The power factor of these motors is controllable, and they may be designed to operate at any desired power factor. They are usually designed, however, to operate at unity or at 80 per cent leading power factor at full load. With this type of motor applications the power-factor problem does not enter, except so far as the motor may be used to correct the power factor of

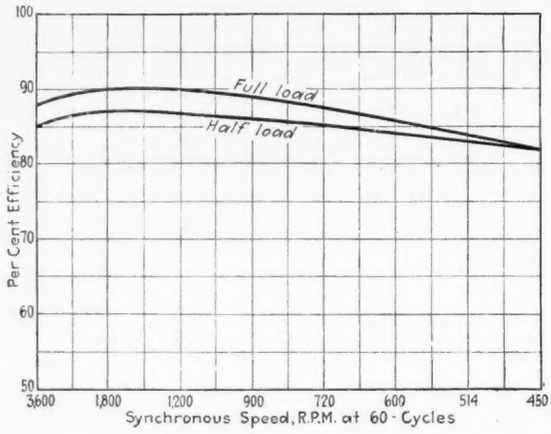


Fig. 5—Curves showing the efficiency of 60-cycle 15-hp. squirrel-cage motors at different speeds

the power system. This may affect the size of the motor selected, in that in many cases a larger motor is installed than is required to drive the load and the excess capacity is used to correct the power factor of the system.

Small slow-speed synchronous motors of the conventional types can be designed for lower capacities than can

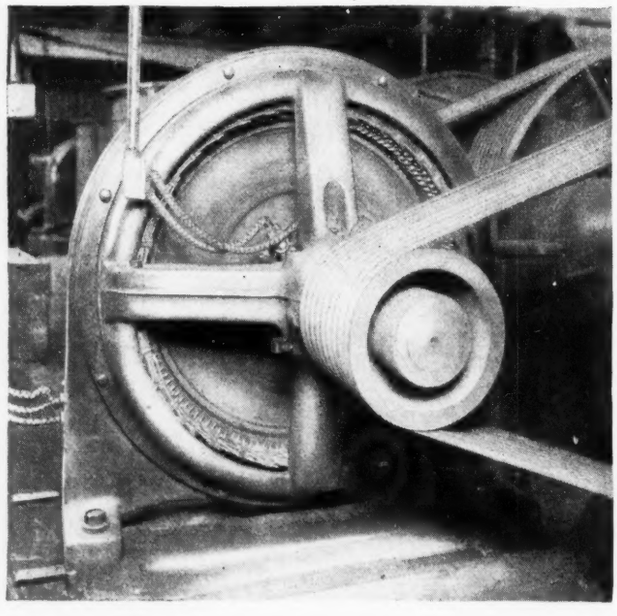


Fig. 6—Synchronous motor connected to a paper-mill beater by two Texrope drives

high-speed machines. This may allow the use of slow-speed motors on applications for which high-speed designs are not obtainable.

When starting synchronous motors, the lower inrush current taken by the slow-speed motor gives it an advantage over the high-speed type. For example, a 100-r.p.m. motor started on full voltage will not take any greater current from the line than a 1,000-r.p.m. motor starting on 60 per cent line voltage. This characteristic of the slow-speed motor allows using a simpler and less expensive type of starting equipment, which must be taken into consideration with the cost of the motor.

The starter for the slow-speed motor may consist of a switch for connecting it directly to the line and a field switch. With the high-speed motor means must be provided to apply reduced voltage to the motor; then, after it has attained a certain speed, disconnect it from the low voltage and connect it to the line and close the field switch. This not only increases the cost of the starting equipment and complicates the starting operation, but increases the maintenance costs. These considerations may be a deciding factor in favor of the slow-speed motor.

Synchronous Motor's Efficiency

The cost of slow-speed synchronous motors will always be higher than the high speed, the relation between the two being somewhat in the order given for the induction type. This will be influenced by the difference in the cost of starting equipment, as previously mentioned.

Like the induction motor, the efficiency of the slow-speed synchronous motor is lower than that of the high-speed motor, this difference being more marked for the 80 per cent power-factor motors than for the 100 per cent power-factor motors. For example, the full-load efficiency of a 100-hp. 100-r.p.m. synchronous motor is about 88 per cent, and for the same size machine at 1,200 r.p.m. the full-load efficiency is about 92.5 per cent. This is a difference of 4.5 per cent in favor of the high-speed motor. A motor of this size for 80 per cent power-factor operation will have an efficiency of 82 per cent when designed to operate at 100 r.p.m. and 90 per cent efficiency at 1,200 r.p.m. In this comparison the difference in efficiency is 8 per cent in favor of the high-speed motor. In either case when the losses of a good speed reducer are included, the high-speed motor has an advantage in efficiency over the slow-speed machine.

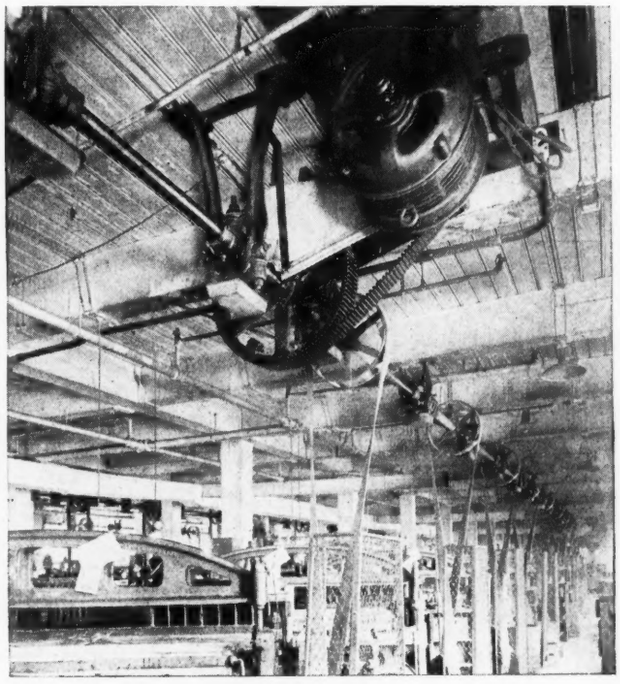


Fig. 7—Lineshaft connected to induction motor through a silent-chain drive

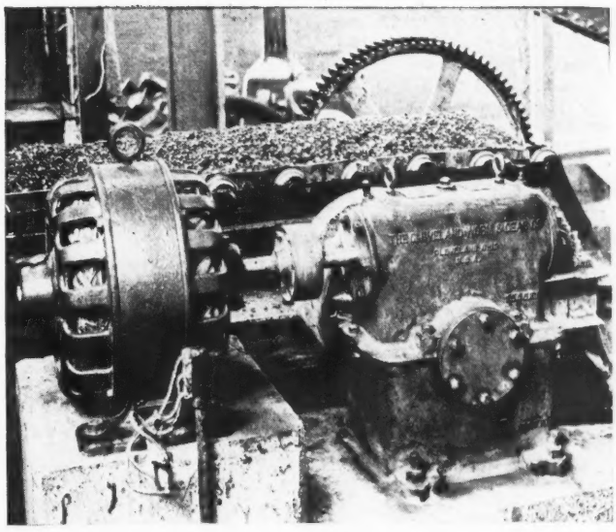


Fig. 8—Squirrel-cage induction motor rated at 4½ hp. geared to an apron conveyor in a cement plant

With direct-current motors power factor does not enter into the problem. Whether the motors are of the slow-speed or the high-speed type, practically the same kind of starting equipment will be required. Where alternating-current motors may be operated at almost any speed fixed by the frequency of the circuit, direct-current motors are limited to a degree by commutator requirements. For this reason general-purpose direct-current motors are not usually operated above about 1,800 r.p.m.

Although the cost of direct-current motors of a given capacity varies almost inversely as the speed, they can be designed for much lower speeds than can induction motors. A good example of slow-speed direct-current motor design is those used on direct-traction elevator machines, which operate at about 70 r.p.m. The efficiency of direct-current motors decreases with the speed as for other types. This makes it possible to use a speed reducer with the high-speed motor and obtain an efficiency of conversion equal to or better than the slow-speed machine directly connected.

In the upkeep of the equipment the cost of maintaining the speed reducer must be included with that of the high-speed motor. This cost should not be much in excess of that for the slow-speed motor alone. The cost of maintaining the speed reducer, like that of the motor, will depend upon the type, the attention and the care it is given.

No hard and fast rule can be laid down as to when a high-speed motor or a slow-speed motor should be used. There are many factors that must be considered outside of the electrical discussed in the foregoing. Each application must be considered on its individual merits if the best arrangement of drive is to be selected.

Refrigeration

THE NEW FISHERIES

*An Ancient Industry Recreated by Refrigeration**

By Harden F. Taylor
Vice-President, The Atlantic Coast Fisheries Company

THE refrigeration industry has always shown great, perhaps too great, deference to the prevailing public suspicion of cold-storage foods, especially foods that have been stored in the frozen condition. However, so far as the fish industry is concerned, scientific discoveries have given us a vastly improved technique of applying refrigeration to fish. They have demonstrated beyond a doubt that when fish are refrigerated by these improved methods, they can be placed in a distant consumer's kitchen in the frozen condition and be in vastly better condition than they would be if shipped in the so-called "fresh" condition.

Up to the end of the Great War, the two methods of handling fish were shipment in cracked ice for fresh fish and the freezing in cold rooms for storage fish. Both practices were great advances over the older art, but left much to be desired. The shipment of fish in ice employs a temperature of about 31 deg. F., minimum, as a preservative. At this temperature neither of the two agencies of deterioration, autolysis and decay, is arrested. They are merely retarded, the prime quality of the fish giving way to an advancing staleness which eventually becomes decay. The customer rarely receives iced fish that are the equal of perfectly fresh fish, although, if delivered promptly, they are entirely wholesome.

In the frozen fish considerable damage had been done by the formation of crystals of ice in the tissues during the slow process of freezing. Subsequent defrosting results in the loss of much juice, containing flavor and nutriment.

In both the fresh and frozen fish, the bones, skin, head and often the viscera were transported to the retail market or the ultimate consumer. This nuisance made cleaning a disagreeable and odoriferous task, and limited the business to fish markets where other foods were not purveyed.

One of the earliest findings was the slow freezing results in the formation of large crystals and that, if the freezing is sufficiently rapid, crystals either do not form, or if they form, they are for practical purposes without effect. Rapid freezing can be accomplished by extremely low temperatures, but diminishing efficiency of refrigerating machinery at low temperatures makes this procedure uneconomical. Rapid freezing is better attained by good contact of thin portions of fish with a good conductor of heat.

The benefits of rapid freezing were not, however, all that were necessary. It was found that rapidly frozen fillets remained for a few days essentially in their original condition, so that when they were defrosted, they were indistinguishable from the fresh fillets. But if the fillets are stored frozen for some time, several changes slowly occur. They acquire a yellowish color, and, when defrosted, a large amount of juice may be lost. These changes were found to be chemical and physicochemical, resulting in the loss of the gelatinous consistency of the cell contents, leaving harsh, coagulated muscle fibers freely running juice. These changes are of a nature entirely different from the crystallization phenomena. Simple remedies were found for these difficulties once their nature was made clear by extensive chemical research. Furthermore, it was found that rapidly frozen fish may in time of storage acquire all the characteristics of slowly frozen ones, through fluctuations in temperature. Large crystals seem to grow at the expense of the

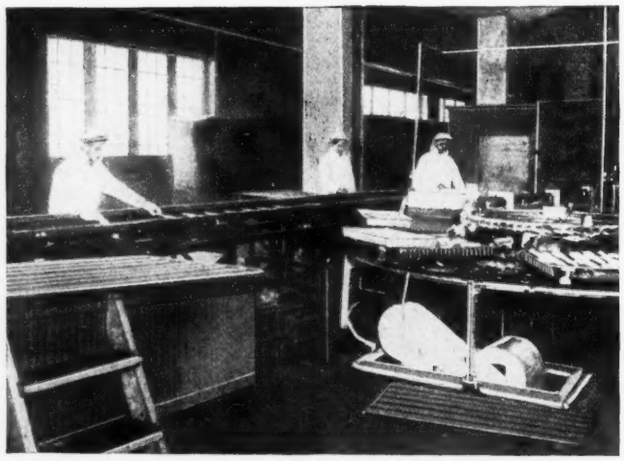


Fig. 1—Conveyor on which the fish fillets are frozen and the circular table where they are packed

*Abstract of paper presented before the spring meeting of the American Society of Refrigerating Engineers, Detroit, Mich., June 7, 1928.

smaller ones. Dessication will ruin the fillets in a storage room of low relative humidity unless suitable packagings are designed to prevent it.

The fish live at a water temperature of about 45 deg. F. When they are dressed on deck, they are packed in crushed fresh-water ice. Improvement here is indeed desirable, though far from easy. Sea-water ice has been tried, and also ice containing sodium hypochlorate. But sea water is chemically not the proper mixture, for the body juices of most fish are markedly dissimilar to sea water in composition. The living fish are able selectively to absorb needed chemicals from sea water and to exclude those that are not needed. When the fish die, this peculiar selective ability is lost and the fish will absorb the salts of sea water indiscriminately. The sodium hypochlorate ice was not successful, for it is ineffectual unless it is added in quantities sufficient to damage the fish.

Mechanical refrigeration has not been successfully applied on trawlers. The difficulty here is in the poor accessibility of the fish to refrigeration. The chemical changes that occur in fish immediately after death are

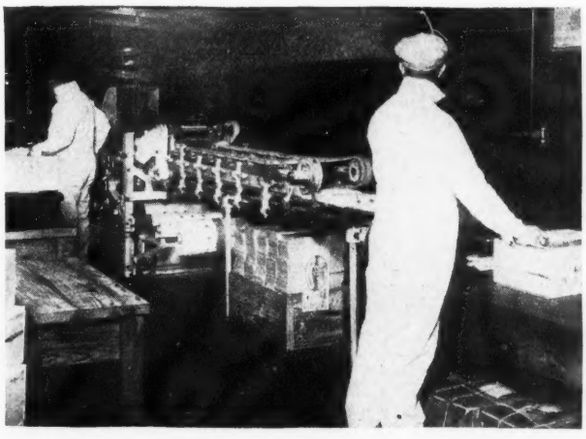


Fig. 2—Automatic machine for wrapping the fish

exothermic; that is, they liberate heat. Packed in dense masses, as they must be for lack of space aboardship, the fish retain this heat and are damaged quickly unless the refrigerant, ice, is mixed with the fish. Accurate temperature measurements show that the fish on arrival ashore are at temperatures varying from 30.5 deg. to 32 deg. F. These temperatures below the freezing point of water are caused by the presence of the salts of sea water in contact with the ice.

On arrival at the plant, the boats are unloaded and the ice is separated from the fish. The fish, after having been weighed, are re-iced with fresh ice and are conveyed to bin rooms, from which they issue by automatic conveyors to the cutting room. The fillets are cut by hand, free from bones, and the skins are removed. During the cutting period they may rise in temperature to 36 deg. or 38 deg. They are then brined continuously in an automatic machine, in a cold brine which again chills them to about 31 or 32 deg. In addition to the chilling the brine serves other purposes, such as rinsing off adhering scales and making certain chemical readjustments that have been found by extensive study to be necessary. The composition and concentration of the brine are

Fig. 3—The package of fish fillets ready for shipment

maintained exactly constant and correct by automatic apparatus.

The fillets, now at 32 deg., are conveyed to the automatic freezer, which is continuous in operation. It consists of horizontal rectangular plates of aluminum with thin parallel ribs on the lower side. These ribs dip, as the plates travel on rollers engaging rails, into calcium chloride brine at from —15 deg. to —20 deg. F. The plate is thus refrigerated and the fillets frozen in about 40 minutes. The plates, still continuing their circuitous travel, rise slightly to pass out of the cold brine tank, and likewise dip again into a tank of calcium chloride brine at about 70 deg. F. This slightly warms the plates and frees the fillets so that they may be removed.

The fillets are then sorted on a machine and are conveyed to a wrapping machine which wraps them at the rate of about 30 a minute. The package consists of a manila cardboard $5\frac{1}{2}$x15 in., paraffined on both sides. The fillet is laid on this card and both are covered with vegetable parchment and paraffined on both sides. The paper is sealed by application of heat from a brass plate built in the machine. Each package contains one fillet. These are packed, in lots of 15 lb., in a corrugated carton lined with impervious paper cemented on with hot asphaltum. Repeated tests have shown this to be necessary, not only to prevent desiccation in storage, but to exclude foreign odors and flavors with which the air of a storage room may be charged. The boxes are taped along all the seams with gummed tape.

The resultant dry package is now placed in a storage room at 0 to 6 deg. F. It remains here 48 hours for temperature equalization and is then shipped, but it may, if occasion demands, remain for long periods without material change.

For shipment these boxes are conveyed by spiral chute and roller conveyor into the refrigerator car. Because of the unsatisfactory performance of the ordinary ice-bunker cars in warm weather, much experimenting has been done with refrigerator cars. Dry ice, of CO_2, was tried in 1926 on about 25 carloads, but was finally abandoned because of excessive cost and not altogether satisfactory results. Iced cars serve in cold weather, but because of the risk in warm weather, resort is being had to cars refrigerated with silica-gel absorption of SO_2. Such a car has been in this service now for several trips to points in Texas, all of which have been entirely satisfactory. Twenty-five of these cars are now being built for this service. They work on the absorption principle with SO_2 gas, with automatic-control features. Trips up

to nine days have shown maximum temperatures of 15 to 19 deg. F., and lower temperatures can be maintained, if desired, but by the burning of more fuel.

For the retail trade the ordinary ice box has been used, but electric refrigerators are now being introduced. These are special in the sense that the thermostats are set to maintain about 20 deg. F. instead of the usual 40 deg. F. and that the boxes are more heavily insulated. The retailer keeps the fillets frozen until they are sold, and the housewife may have them in her kitchen frozen and unchanged since the day they were received from the boat 2,500 miles distant. Refrigeration has been applied at every instant.

This rather elaborate system, technical and commercial, has many advantages over the older method of distributing fish. Its primary object is, of course, to deliver first-class fish to the consumer. In doing so, it has removed the peaks and valleys of both production and demand. It utilizes waste to pay the costs of manufacture. It delivers a sanitary package of fish, all of which is edible, under the name and trademark of a responsible manufacturer, to consumers anywhere on the continent, and even in foreign countries. It displaces expensive express transportation, with the more economical carload-lot freight transportation, without risk. It opens up the grocery and chain store as well as butcher shop as a distributor of fish. It enables these stores to have fish on hand at all times without any loss whatsoever; delivery can be had on short notice—in fact, notice is unnecessary, for local distributors, on a systematic route, keep all refrigerators supplied at all times.

This is another example of how the technical man is solving industrial problems and extending the consumption range of food items. Without the aid of the refrigerating engineer the fishery industry would be handicapped in its marketing and the inland population would be limited to salted sea food. In no other industry has the life of the business been given such a new lease as has been the case of the fishing industry, which is no longer a local marketing proposition.

Compensating the Ammonia Pressure Gage for Liquid Head

IN BOILER-ROOM practice it has been the custom of some engineers to set the steam gages so as to compensate for whatever head of water there might be in the connecting piping. This can be done either by measuring the vertical height of the water head, calculating the equivalent pressure and setting the pointer of the gage back the corresponding amount, or by allowing the pipe to fill up with water and then setting the pointer by comparison with a standard gage properly connected to register the true gage pressure on the steam vessel.

In dealing with ammonia under pressure, the problem is not quite so simple. If, for instance, the liquid ammonia leaves the condenser at 80 deg. F., and if the atmosphere is 70 deg. F. in the engine room, then the line from the discharge header to the head pressure gage will gradually fill up with liquid ammonia. In fact, this will occur at all times when the room temperature is below that of the liquid ammonia leaving the condenser.

Fig. 4—A fish car provided with silica-gel refrigerating

It often occurs that this line will have enough vertical rise to represent a 15- or 20-ft. head of liquid ammonia, and this is sufficient to cause the gage to indicate a pressure several pounds higher than the condenser pressure. Yet we cannot compensate for this in the same way as is done on steam gages, for when the room temperature rises to a value above that of the ammonia leaving the condenser, the liquid in the gage line will evaporate out again, owing to the fact that the head pressure is less than the boiling pressure corresponding to the new temperature.

Thus it is seen that we may have a liquid head varying from nothing to the full vertical height of the gage line, depending upon weather conditions. The head pressure indicated by the gage cannot be relied upon by the operating engineer.

A good solution of this difficulty is to fill the line with ammonia oil and compensate the gage for this condition.

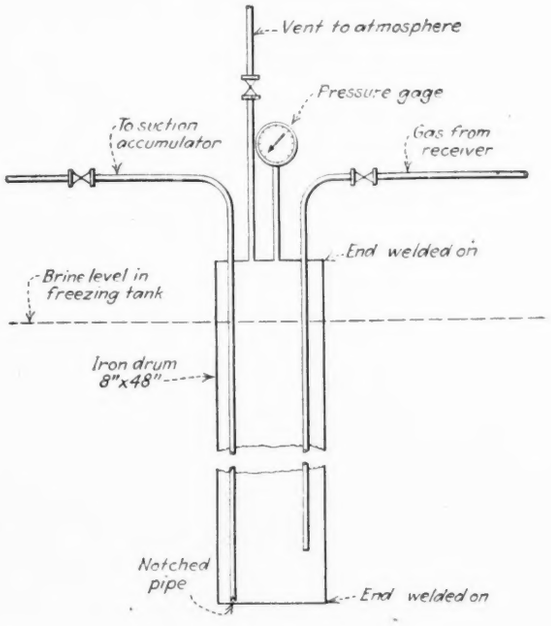
Refrigeration

Purging the Ammonia System

By M. F. Knoy

PERHAPS all refrigeration engineers are convinced of the need of purging the high-pressure side of the ammonia system whenever a comparison of the temperature of the liquid ammonia leaving the condenser with the head pressure reveals the presence in the condenser of a considerable proportion of foreign gases. But purging is often inconvenient and some ammonia is always wasted; hence, there is a tendency to avoid purging until the head pressure really becomes excessive.

One way to make purging more convenient is to place a purge connection on the liquid line between the condenser and the receiver so that the operator may purge while the system is in operation. Some engineers of the old school are opposed to this practice. They maintain that the proper thing to do is to shut down and leave the condenser water running for awhile. They believe that most of the ammonia will be condensed and that the foreign gas will come to the top of the condenser, where it may be easily eliminated by purge connections located at this point.



A simple form of purger

A study of the behavior of gas mixtures will convince one that this is a poor theory. In the first place the ammonia will not condense beyond the point where its vapor tension corresponds to the temperature of the cooling water. And in the second place, the ammonia and whatever other gases may be present will be equally mixed throughout the condenser, the liquid line to the receiver and the space above the liquid in the receiver. One part of the system is as good to purge from as another if the plant is shut down; but if in operation it is better to purge from the liquid line or from the top of the receiver. For the discharge gas from the compressor entering the condenser at high velocity has a tendency to keep the foreign gases swept out and concentrated in the liquid line and the receiver.

At any rate, whether purging from one of these points or another, some ammonia will be wasted and, if ordinary practice is followed, the amount is considerable. Suppose, for example, that the liquid ammonia leaves the condenser at 75 deg. F. The gas will have a pressure of 141 lb. per sq.in. abs. and will weigh 0.479 lb. per cu.ft. Now if there is an excess pressure of 10 lb. per sq.in. due to the presence of air, each cubic foot of ammonia will carry with it a cubic foot of air at this pressure. Using the formula for air, $PV = MRT$, this air is found to weigh $144 \times 10 \times 1 \div M[53.37 \times (460 + 75)]$, or $M = 0.0504$ lb. Or, in other words, there will be liberated $0.479 \div 0.0504 = 9.5$ lb. ammonia for each pound of air removed at 75 deg. F.

A step in the way of saving ammonia may be taken by passing the purged gases under pressure through a low-temperature chamber where most of the ammonia may be condensed out and saved. If, for instance, the mixture were subjected to a temperature of 16 deg. F. in a closed vessel, a part of the ammonia would soon condense out and allow the pressure to fall. If, now, more of the mixture were admitted until the pressure reached, say, 144 lb. per sq.in. after cooling to 16 deg. F., it would mean that approximately 44 lb. per sq.in. of this pressure was due to ammonia vapor and that the remaining pressure of 100 lb. per sq.in. was due to air. If a cubic foot of this mixture were liberated, it would represent 0.1573 lb. ammonia and $100 \times 144 \times 1 \div M[53.37(460 + 16)]$, or $M = 0.586$ lb. of air. The pounds of ammonia released per pound of air will be 0.268 and dividing by 9.5, which we found to be pounds of ammonia lost per pound of air eliminated by the usual method of purging, the ammonia lost by low-temperature purging is found to be only 2.8 per cent of the former amount. In other words, by the low-temperature method we save about 97 per cent of the ammonia usually wasted. Of course, these exact figures could not apply to a case where the proportions of the ammonia and air were different, but the same method of calculation could be used.

There are on the market several types of low-temperature purge drums. Though differing in construction details, they are all based on the principles set forth herein. In fact, I have obtained satisfactory results by the use of a drum constructed as indicated in the accompanying diagram. The cooling was achieved by simply immersing the vessel in a corner of the freezing tank.

Ammonia Liquid May Be Precooled in several different ways. It may be cooled by water in a double-pipe-counter-current cooler, through which is passed the coldest water on the way to the ammonia condensers. This method has met with only small success. Liquid ammonia may also be cooled by direct expansion in a double-pipe counter-current cooler, or it may be cooled in an intermediate receiver. By the latter method the ammonia passes through a large-sized expansion or regulating valve into an intermediate receiver. This regulating valve is controlled so as to maintain a constant level of the liquid in this receiver. The receiver is of course insulated, and the resultant boiling of gases is taken care of by a small ammonia compressor, the speed of which is governed by the back pressure desired in the intermediate receiver, which is ordinarily from 30 to 35 lb. gage. The small compressor, of course, discharges into the main battery of condensers. This method is used a great deal in large installations especially in connection with two-stage compression.

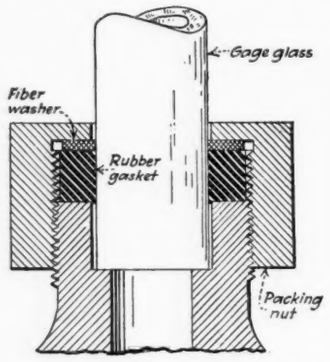
Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Use of Fiber Washer Stopped Gage-Glass Troubles

IN OUR plant a great deal of trouble was experienced with the gasket rubbers on the gage glass blowing out, causing the glasses to break, until the following was tried.

Several kinds and makes of rubber packing rings were tried, but most of them held only a short time, although



Fiber washer prevents rubber gasket pushing

there were a few that were satisfactory. To get around the trouble a fiber washer $\frac{1}{16}$ in. thick and $\frac{3}{4}$ in. inside diameter and with an outside diameter to allow an easy fit into the gage-cock nut, was put into each nut before the rubber gasket. The fiber washer fitted the glass fairly close and would not allow the rubber gasket to push out between the glass and hole in the nut. This plan was tried with gaskets that normally held only an hour or two, and is holding them securely.

The fiber does not scratch the glass, therefore will not cause it to crack and break, as would a metal washer or a nut with too snug a hole in it. The fiber washers were purchased at a machinists' supply house and were the proper size to use. Where various sizes of glasses are used, almost any size of washers desired can be purchased. They are so inexpensive that when it becomes necessary to replace a glass, the old fiber washers can be discarded and new ones put in their place.

Denver, Colo. F. R. RAWSON.

Carbon-Type Electric Soldering Device

IN THE diagram is shown an electrical soldering device that I have found to work conveniently in places where it is not safe to use a flame for heating. The soldering part consists of a piece of $\frac{3}{4}$- or $\frac{7}{8}$-in. carbon held in a clamp, which is provided with a handle for easy manipulating. The carbon clamp is connected to one side of a low-voltage transformer, and the coil or other device to be soldered is connected to the other terminal of the transformer's secondary.

To use the soldering device, the carbon is placed on the part to be soldered and current flows through the carbon and the connection to be heated. This raises the temperature to the melting point of solder. I also use a thin copper wedge that can be heated by holding it against the carbon. This wedge is used to smooth up the solder. A little practice with this equipment will show that it can be used in several ways.

The device is safe and simple and the current can be varied by regulating the length of the carbon between the clamp and the point being soldered. I have found that the design of this device may be varied to suit the condition of the work. Ordinarily, the length of carbon between the clamp and the joint being soldered, will be about one inch.

To supply power for doing the heating, I have used a 5-kw. 2,300- to 115-volt transformer with the 2,300-volt side connected to a 115-volt circuit. This connection gives about 5.5 volts on the low-voltage side. In other cases I used a 550- to 110-volt transformer, with the 550-volt leads connected to a 110-volt line. This gives about 22 volts, which makes it difficult to handle the soldering carbon to get good results. A low-voltage transformer made from material available around the plant has been used with satisfactory results. The leads must be of sufficient size to carry the current without overheating or causing too high a voltage drop. J. P. MORAN.

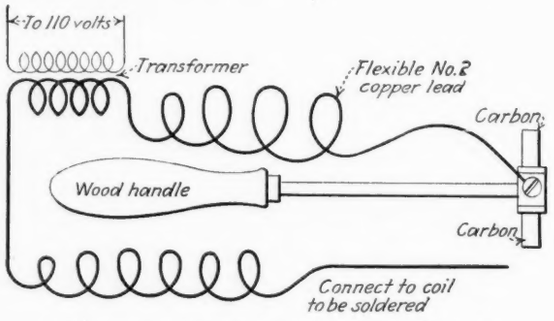


Diagram of electric soldering equipment

Warrenville, S. C.

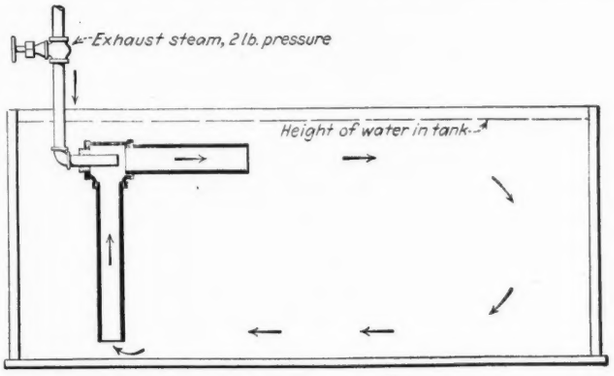
Heating Water or Solutions With Exhaust Steam

A METHOD of heating water or solutions contained in shallow tanks by the use of exhaust steam has proved successful in our plant and may be of interest to others. In one rectangular tank, 6x5 ft. and 3 ft. deep, the contained solution is heated by what might be called an ejector heater, which is shown in the accompanying drawing.

This ejector heats the water in the tank satisfactorily, using steam at one pound pressure. It will be noted that the steam is taken in the top of the ejector, near the top of the water, and is not required to blow into the tank against a head of water. It simply starts the water circulating. As the cold water enters the suction pipe of

the ejector at the bottom of the tank and is discharged with some velocity at the top, the water or solution is heated evenly and rapidly. The speed of heating, of course, depends on the size of ejector and steam supply.

This apparatus has not been tried in a deeper tank, but I see no reason why it should not operate in one much deeper. The only power required is that to circulate the liquid from bottom to top of tank against gravity and the force caused by the tendency of the warmer liquid to stay at the top. There is no great temperature difference at any time, because of the rapid circulation.



Ejector Heater for Tanks

The heater is here shown disproportionately large to bring out the details.

Worcester, Mass. S. E. BALCOME.

Bearing Cooling Water Deflects Shaft

SOME time ago a large synchronous condenser unit was installed, which consisted of the condenser proper and a starting motor mounted at one end on an extension of the mainshaft. There were two main bearings on the condenser and an outboard bearing for the shaft extension on the starting motor. During the dry-out period the unit was run by means of the starting motor and warm air was supplied to the main machine. After several hours' run it was shut down to allow taking temperatures and megger readings. After these readings were taken, the unit was again started and the process repeated, each cycle consisting of about four hours of running time and one hour of shutdown.

When the machine had been started and stopped a few times, it was noticed that on starting the end bracket on the starting motor was weaving, and a check showed the shaft running about $\frac{1}{32}$ in. out of true at the outboard motor bearing. During the five minutes required to bring the unit up to speed the eccentric action disappeared and the shaft ran true. While the unit was being shut down the shaft continued to run true until it was completely stopped, but on starting up eccentricity was present.

Some jumped to the conclusion that the shaft was being deflected by the weight of the main rotor during the shutdown period, but it was difficult to reconcile this conclusion with the fact that after two or three minutes the shaft ran true.

Investigation was made by mounting a surface gage from a support on the floor with a bearing against the end of the shaft, so as to indicate the amount of eccentricity. By carefully watching this gage during the shutdown period, it was observed that as soon as the unit came to standstill the shaft end began to deflect downward and continued to do so for several minutes. This deflection was in the opposite direction from that which would be expected if it were due to the weight of the rotor. An analysis of the action was made, and on the next shutdown cooling water was cut off from the main bearings before the machine came to a standstill. This time the surface gage indicated no shaft deflection.

In order to confirm the idea that shaft temperature was at the root of the difficulty, the unit was again shut down with water cut off, and after it had stood still for several minutes without any deflection being indicated by the surface gage, water was turned on. The shaft immediately began to deflect downward.

Cooling water is applied only to the lower part of the lower half of the bearings, thus cooling the lower side of the shaft and causing the end projecting through the starting motor and to its outboard bearing to bend downward. When the machine was started, the rotation of the shaft soon brought it to a uniform temperature and it straightened out. The experience gave a rather startling illustration of what can happen to a long shaft which is unevenly heated.

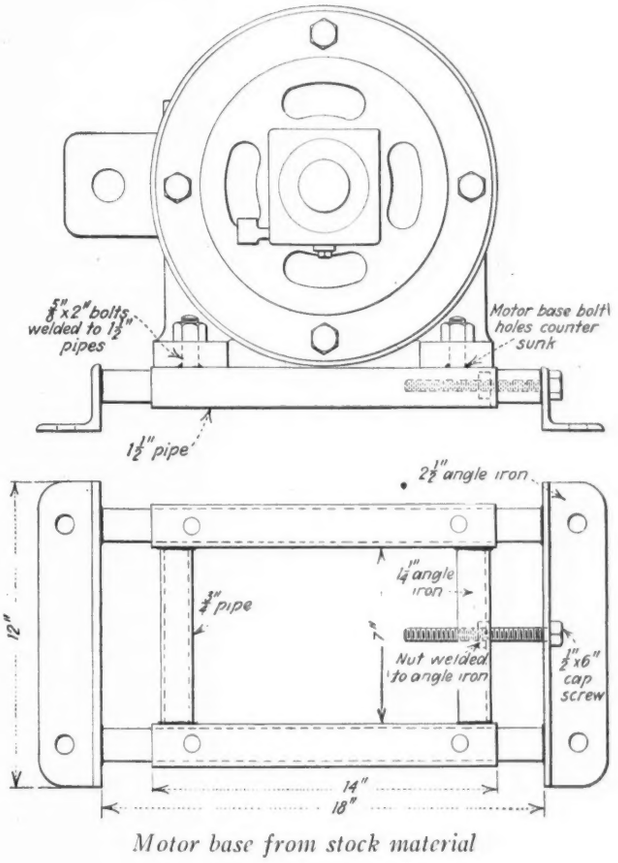
JAMES SILBERSTEIN.

Chicago, Ill.

Building a Motor Base from Scrap

IN OUR 40,000-ton ice-storage plant we had installed elevating and conveying apparatus requiring a total of twenty 5-hp. induction motors, these being connected to the mechanism through spur-gear drives.

The first year's operation resulted in such wholesale stripping and breaking of gears, due to the way the machines were operated, that we decided to change over to belt drives. The motors not being equipped with adjustable bases, the bases shown in the illustration were built from stock material at a comparatively low cost.



Motor base from stock material

Fort Valley, Ga. R. A. HALL.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

Johannesburg Power Situation

IN THE news item entitled "Johannesburg Power Station Finally Sanctioned," which appeared in *Power* a while ago there are two misstatements to which I must call attention.

The Electricity Supply Commission did not "take the view that the supply should be obtained from one of the new superpower stations," but in carrying out its duties insisted that a careful investigation should be made, before the Johannesburg Town Council proceeded with the erection of a new power station, to determine whether the supply could not be given more economically (either wholly or partly) from an existing power system that extends in the immediate vicinity of the town.

Secondly, there is no "chain of power stations being provided by the Electricity Supply Commission primarily for the supply of power to the mines." There is a "chain of power stations" comprising the stations at Vereeniging, Simmerpan, Rosherville, Brakpan and Witbank, but the first four belong to the Victoria Falls & Transvaal Power Company, and only the Witbank Station, situated 90 miles from Johannesburg, belongs to the Commission.

The Witbank station supplies the major part of its output to the network of the Falls Company and so, indirectly, to the mines.

As the whole output of the Witbank power station is sold at all times, the Commission had no interest, from a loading point of view, in seeing the Town of Johannesburg take a supply from the power network which passes its doors, but which is in no way controlled by the Commission.

A. M. JACOBS,
Johannesburg, S.A. Commissioner (Engineering.)

* * * *

Honest Service in Business

IN THE annual review and progress in design number of May 29, the editor summarized the developments of the year and drew certain conclusions that promised well for the future, but failed to mention the most striking and the most promising feature of the review number, the advertising section of the paper. This may have been for ethical or other reasons, but gem is gem no matter where it may happen to be, and there should be no reason why proper mention should not be given it.

The life of any industry is the man. The object of any industry is service. Intelligent service always is fearless, upright and striving to improve and grow in magnitude and diversity. Now, with these comments in mind, let us go over the following declaration, appearing on one of the advertising pages.

"We, of the International Combustion Engineering Corporation are firmly committed to the idea that coal can no longer be looked upon as merely a fuel to be wastefully burned—but must be considered as a raw basic product to be so processed that each of its constituent elements may go to serve most fully its greatest economic use." Signed, George E. Learnard, President.

This declaration not only promises well for the future, but assures permanence and prosperity to the business founded upon the upright desire to serve well.

There is no more reason for burning raw coal than our inability to do better. Whether low-temperature carbonization will solve the problem or whether some combination of carbonization, gasification and liquefaction of coal may have to be evolved, the future will decide. Besides the economical consideration, in the present stage of our industrial development serious thought must be given to health as affected by air supply. Any method of solid fuel burning, be it ever so smokeless, does not commend itself as the ultimate solution of heat production from fuel. Discharge of solid matter, which invariably follows the burning of solid fuel, will not be tolerated in densely settled communities in the near future.

In conclusion, with apologies to Mr. Learnard, I would say that coal must be considered as a raw basic product to be so processed that each of its constituent elements may go to serve most fully its greatest economic use without harmfully affecting the public health.

Chicago, Ill. HENRY MISOSTOW.

* * * *

Does the "Home-Made" Policy Pay in the Power Plant?

WHILE almost every practical suggestion in *Power* has been of real value and interest, occasionally one crops up that makes me wonder whether the home-made policy is not carried a bit too far.

Of course it is often next to impossible to purchase some items at certain times, and this might excuse the construction of some device, such as a forge furnace out of scrap materials, on the plant. Yet when the cost of assembling the parts, welding, cutting, construction, cost of operation of a cruder device, etc., were added it might have been cheaper to purchase a new forge outright.

There are many plants where such rigid economy is practiced that it is next to impossible to purchase outside equipment. The makeshifts resulting from inventive necessity often become ludicrously tragic. I believe this is usually traceable back to the management, but occasionally the workmen pride themselves on their inventive genius in creating their own devices.

Of course, each plant has its own methods of doing some things that enable them to improve on purchased materials with some of their own kinks. Most plants have suggestion contests and rewards for meritorious ideas. These encourage "home-made" devices of merit.

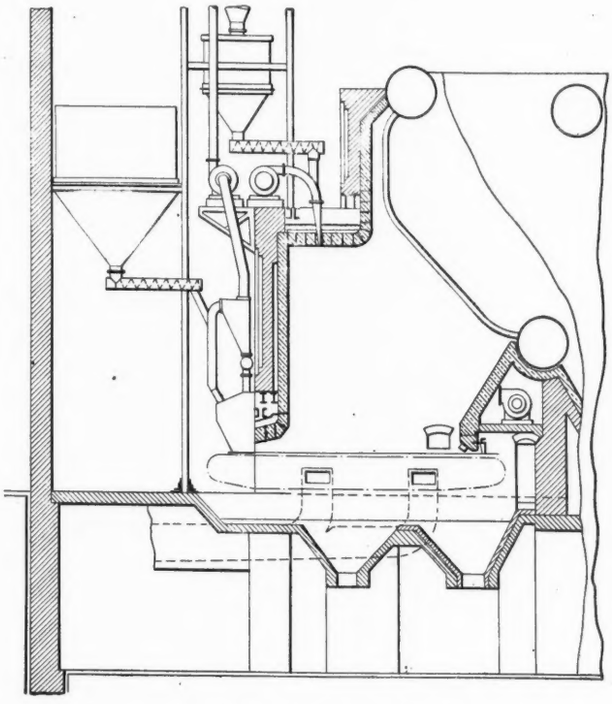
However, it behooves one to be on the watch to see that unnecessary expenditures of material and labor are not made on crude, inefficient devices that can be bought more cheaply and of superior quality on the open market.

At this time especially, manufacturers, by means of regular production methods and comparatively low prices, can well compete with high plant labor costs involved in building single devices. L. G. JONES.

Pittsburgh, Pa.

Chain-Grate Stoker Operates Without Ignition Arch

IN THE issue of March 22 there is a description of a chain-grate stoker for which it is claimed that it will operate without an ignition arch. To those skeptical about the possibility of dispensing with the arches on chain-grate stokers, it will be of interest to know that



Arrangement of boiler stoker on which tests were conducted

attempts in this direction in Germany have met with considerable success. Not alone is it claimed that perfect ignition is obtained with the new arrangement, but the increased heat absorption through radiation by exposing

BOILER-TEST DATA

Heating surface, sq.ft			2,860
Superheater, sq.ft			416
Grate area, sq.ft			70
Steam pressure, lb. abs			160
Superheat, deg. F			150
Feed-water temp., deg. F			70
Test	1	2	3
Duration	7 hr. 2 min.	6 hr. 3 min.	6 hr. 11 min.
Coal	Slack-anthracite	Semi-bituminous caking	Bituminous R.O.M.
Proximate analysis:			
Moisture	3.53	15.04	3.84
Volatile	7.94	14.10	25.24
Fixed carbon	81.06	57.20	51.04
Ash	7.47	13.66	19.88
Average calorific value	13,650	10,250	11,200
Total coal burned, lb	15,600	12,600	13,300
Coal burned per sq.ft. grate surface per hr., lb	32	30	26.5
Flue-gas analysis:			
CO_2, per cent	13.8	13.9	12.8
O, per cent	5.7	6.1	6.6
Excess air, per cent	37	41	46
Evap. from and at 212 deg. F per sq.ft. heating surface per hr., lb	7.3	6.1	6.7
Evap. from and at 212 deg. per lb. coal as fired, lb	8.83	7.8	8.4
Heat balance:			
Heat absorbed by boiler and superheater, per cent	69.72	82.51	74.03
Loss in chimney gases	18.48	16.40	18.12
Unconsumed carbon	3.15	2.05	3.65
Radiation and unaccounted for	8.65	5.04	4.20

the heating surface to the whole grate area is regarded as a decided advantage. This is, of course, offset by a less perfect combustion than that obtained by the use of arches, which tend to give better mixing of the combustible gases.

The accompanying illustration shows an installation on which tests were made in 1927 to show the efficiency and suitability of this archless chain-grate stoker for burning the different grades of coal. The original object of the auxiliary powdered-coal equipment shown in the picture was to provide the capacity required to take care of the peak load, as it was doubted that the stoker without arches would suffice for high ratings. As the stoker proved to be of sufficient capacity without the aid of the powdered-fuel equipment, the latter was discarded. Besides the grades of coal shown in the accompanying table, such coals as coke breeze and lignite have been burned successfully with this stoker and it is claimed that the change from one coal to another requires only minor adjustments. In fact, the absence of ignition arches makes it possible to change readily from one grade of coal to another.

A. WEISSELBERG.

Brooklyn, N. Y.

* * * *

The Man With a Patent

IN THE April 10 issue C. J. Cotterel has some interesting and instructive things to say concerning patent matters, up to and including the issue of the patent, but I have found from experience that a man has only started when he pays the final government fee and becomes the proud possessor of letters patent covering his invention.

What Mr. Cotterel says about the path being filled with pitfalls, hazards and numerous obstacles to be overcome, still holds good after the patent is issued.

When a patent is issued, a small sketch or drawing of it along with the claim or claims allowed is published in the *Patent Office Gazette;* also the inventor's name and address.

The inventor's mail immediately becomes full of offers from firms and individuals in various places, to help him make a fortune from his invention.

These offers are sometimes flattering, and they usually sound good to the uninitiated, but the great difficulty with most of them is that the inventor must first pay a sum of money as a pledge of good faith, to avail himself of the benefits of the offer.

Personally, I have never received any benefit from any such offers even after paying the advance fee asked, but as I have not tried all of them, I do not wish to go on record as claiming that all offers should be rejected, since I might have received benefit if I had spent my money on the right offer.

I was disappointed that Mr. Cotterel did not go on and tell how to make money out of the patent after it is issued.

From my own experience, I would say that there is nothing more discouraging than to try to interest a manufacturer in a new patent to the point of buying it outright or signing a royalty contract, no matter how good it may be. If it is different from this, I have never met the right manufacturer.

The inventor usually thinks that the world will be clamoring for his invention and starts out in high spirits, but after corresponding with a number of manufacturers of machinery or products of a similar line, he begins to wake up and think that it is not going to be so easy after all. A year or so of this satisfies him that a patent is a hard thing to sell, and he will then probably decide that he will manufacture and sell.

Accordingly, he spends hard-earned money for patterns and machine work and makes a machine or whatever product it may be, and when completed, maybe it will sell and maybe not. If it sells at a profit, well and good. He can then build another and perhaps sell it also, but if he does not sell, his capital is probably all tied up in the machine and there is no course for him but to give up or raise more money to further exploit his invention.

It is possible that at this point he will attempt to organize a company and sell stock to the public to raise the necessary funds to carry on, but the public is pretty well fed up on stock promotion schemes, and in all probability he is a much better inventor than organizer, and the company scheme falls flat.

His next move will undoubtedly be to try to sell a half interest in the patent, and if the invention is really worthy, he is fortunate if he does not sell to some unscrupulous person who will take advantage of him.

If he actually succeeds in selling a half interest and accepts a partner, they can continue to exploit the invention until the money put in by the partner is all gone, and still the business may not be paying, and they may have to raise more money or lose what they have put in.

If the partner is unscrupulous and foresees that the invention will be a success if unhampered by the lack of capital, he will probably refuse to put more money into the venture, and the inventor will become so discouraged that he will be ready to quit, and it will be an easy matter for the partner to buy him out for little or nothing, and after the unscrupulous partner has the invention all in his own hands, he advances the necessary amount of capital and the invention becomes a financial success, but too late to benefit the inventor.

It sometimes happens that the partner who has spent his money for a half interest is the one to get disgusted and quit, leaving the inventor without further funds and his patent tied up so that he could not sell it if he should get a chance, for he will not be able to buy the partner out, and he cannot transfer it as a whole unless the partner consents to sell his interest also. It is almost a certainty that no company would be found that would buy the inventor's half interest without that of his partner.

It takes grit to stick after this and struggle further, and usually the inventor will decide that he has invented the wrong thing and turn his attention to some new idea that he has conceived and that he thinks there will be more demand for, and his patent lies idle, making him nothing, and he would have been better off without it except for the experience he has gained.

It is probable that the patent will expire without enriching anyone.

Of course this is the pessimistic view, and there are always two sides to any question. There are patents that have been successful from the start and that have made their owners wealthy, but they are the exception rather than the rule.

Patents taken generally are mediocre and worth only what can be gotten out of them, but once in a while some genius invents something that is outstanding, contacts with the right manufacturer and makes everyone connected with the enterprise, as well as himself, immensely wealthy.

In spite of the discouragements, it is a fascinating game, but so is gambling, and it is presumed that the element of chance in a patent is the thing that makes it fascinating.

An inventor will sometimes continue to put money and time in an invention long after his own family and friends have told him that it is useless, and sometimes he wins.

I have made several attempts in the way of invention, but I do not claim to have made any outstanding success thus far. I should be glad to read an article from the pen of some worthy inventor who has made a financial success of it.

EARL PAGETT.

Coffeyville, Kan.

* * * *

Cause and Prevention of Static Electricity

IN THE April 24 issue, page 737, is a short article by W. E. Warner, entitled "The Danger of Fire from Lubricating Oils." In this article he writes about static electricity of belts, saying: "There is also the static electricity generated as a belt passes around a pulley, which may lead to sparking if sufficient static is generated."

My understanding of the generation of static electricity is that it is generally worse midway between the pulleys, and that it is not generated at the pulley but by a belt made of non-conducting material, passing rapidly through dry air. When air is sufficiently moist, there is never any static electricity.

It is well known that if the pulleys are made of metal, they generally serve as an effective grounding connection themselves and will conduct the static, if there be any, into the ground. Of course, if the pulleys are made of wood, it may sometimes be necessary to use combs close to or on them as well as midway between them to collect and lead off any static that may be generated.

In view of the fact that certain manufacturers, such as of explosives, must eliminate all static from danger zones in their plants. I recently did some investigating by letter in an effort to learn how static is effectively avoided. The following are two typical replies:

"Up to a few years ago we used quite a number of rubber and leather belts in our operation, and if memory serves the writer correctly, about the only precautionary measure taken to guard against static electricity was to treat these belts with a composition of glycerin and water. This was done about three or four times a year.

"The only method which we have found necessary on occasions has been to ground our shafts thoroughly and to use a metal comb with an electric ground connection to pick off any static from the belt. Our problems of static in the manufacture of high explosive are not nearly so severe as prevail in the manufacture of smokeless powders."

A belt that is a good conductor of electricity will never give any static trouble. Thus steel bandsaws in woodworking plants, which operate at very high speeds, never give static trouble. Nor do rapidly rotating metallic disks give trouble. It is doubtless remembered by most readers that the old "static machine" which we used in physics class experiments in school and college had glass disks. Glass is a poor conductor. A metal disk will not retain the charge, while glass will.

It has occurred to me that an effective remedy for static electricity would be the placing of a loosely woven fine wire cloth between the plies of double-ply and three-ply belts. That would make a perfect conductor of the center of the belt at least. Occasional treatment with glycerin and water, plus the wire netting, should be very close to 100 per cent effective as a static eliminator.

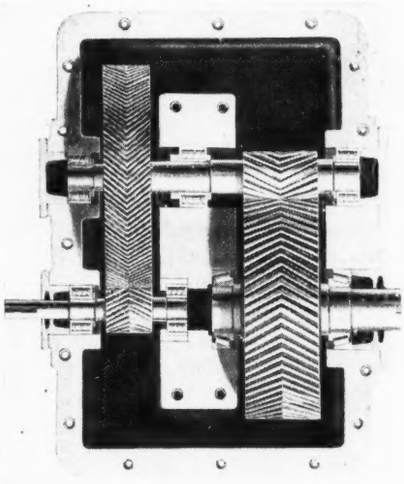
Newark, N. J. W. F. SCHAPHORST.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Improved James Herringbone Speed Reducers

THE D. O. James Manufacturing Company, Chicago, Ill., has recently introduced the new line of generated continuous-tooth herringbone speed reducers illustrated, made in both single and double types.



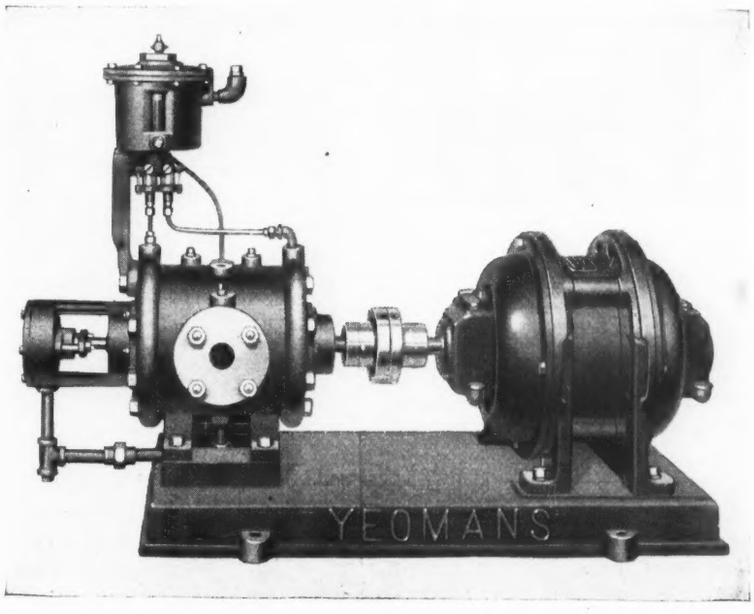
Double speed reducer with two types of roller bearings

These reducers are new in that they are now fully equipped with anti-friction Hyatt roller bearings on the high-, intermediate- and slow-speed pinion shaft, and Timken roller bearings on the slow-speed gear shaft. The illustration shows the arrangement of the high- and slow-speed shafts of a double unit and the two types of bearings.

Yeomans Rotary Air Compressor

A NEW development in small-capacity air compressors for relatively high pressures is shown in the accompanying illustration. Being of the multi-vane type, the discharge of air from the compressor is free from pulsation, and as the construction is such that there is no actual contact between the vanes and the interior surfaces of the casing, relatively high discharge pressures and high speeds are possible and at the same time the wearing qualities are enhanced. This positive motor-driven compressor can be used for pressures up to 50 lb. gage. The volumetric efficiency compares favorably with that of reciprocating compressors of like capacity, and as the rotor is supported on roller bearings and friction losses in the casing are low, the mechanical efficiency is likewise high.

Air-cooled casings are furnished for low-pressure continuous-duty machines and for intermittent service at somewhat higher pressures. The illustration shows a water-jacketed compressor for the higher pressures with a centrifugal cooling-water circulating pump directly connected to an extension of the rotor shaft for use with a gravity cooling tank or hopper, but standard machines are provided with the usual openings for circulating water from the city supply and without a water circulating pump.



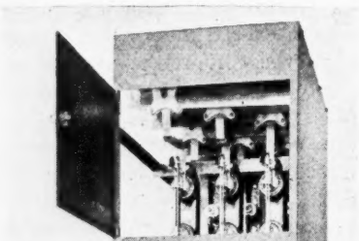
Positive-displacement rotary air compressor with a cooling-water circulating pump and oil economizer

The compressor is equipped also with a Yeomans automatic oil economizer, described in the March 13 issue, which provides lubrication during operation of the machine and automatically shuts off the flow of oil when the compressor is shut down. This economizer has a capacity of one quart of oil and is provided with two adjustable sight feeds, a diaphragm-operated needle valve and a gage glass.

As the compressor is built without stuffing boxes, a seal around the shaft is obtained by means of special metal packing rings. Owing to the positive displacement of air no water seal is required. High speed and consequent low first cost, compactness, light weight, small space occupied and small foundations because of the absence of reciprocating motion are some of the advantages claimed for the new compressor. While it was designed primarily for use with the Shone pneumatic sewage ejector made by the company, the machine is adapted to air-compressor service of any kind within the pressure limit previously indicated, and owing to its light weight is well suited for portable use. The compressor is made by the Yeomans Brothers Company, 1446 Dayton St., Chicago, Ill.

Automatic Reclosing Feeder Equipment

THE General Electric Company, Schenectady, N. Y., has recently introduced a new line of automatic reclosing feeder equipment, arranged in the form of completely inclosed



Feeder equipment arranged in the form of inclosed cubicles

cubicles. These cubicles contain a circuit breaker and disconnecting switches and are operated automatically by relays mounted on the front panel.

Heretofore the automatic reclosing feature has been available only in the open type of equipment. The new cubicle construction has been designed to exclude dust and dirt from the operating parts and to provide the feature of safety which is so important in the dead-front type of switchboard apparatus now coming into use for inside installation.

Circuit breakers and disconnecting switches are mounted on a channel frame which also supports the walls of the cubicle. The front panel is arranged in the form of a door, and on it are mounted the necessary relays and meters for providing the automatic reclosing feature. On the back of this panel is located all the control wiring, which is therefore easily accessible. A rear door affords a means of conveniently inspecting breakers and all breaker parts.

The cubicles are made in standard sizes and in ratings up to 7,500 volts. They may be arranged side by side to form a continuous switchboard.

Standardized Jeffrey Belt Carriers

THE Jeffrey Manufacturing Company, Columbus, Ohio, has standardized its carriers for belt conveyors so that the same stands and bases can be used with any one of three types of pulleys—the plain bearing, the bronze-bushed, and the roller bearing, as illustrated.

The pulleys are made with open

Fig. 1—Plain and bronze-bushed bearing pulley

Fig. 2—Anti-friction bearing pulley

ends, and arms and ribs are used to join the hub and roll. The gray iron of which the pulleys are made contains considerable free carbon, which acts as a rust repellant, and it is claimed that such pulleys resist corrosion much better than steel pulleys, especially on wet jobs such as conveying washed sand or gravel.

Pulleys with plain or bronze-bushed bearings, as shown in Fig. 1, have hubs especially cored out to form large recessed grease pockets connecting with a pressure lubrication fitted at the end of the hollow shaft. These grease pockets are useful on long belt conveyors where a few pulleys are likely to be skipped over or neglected.

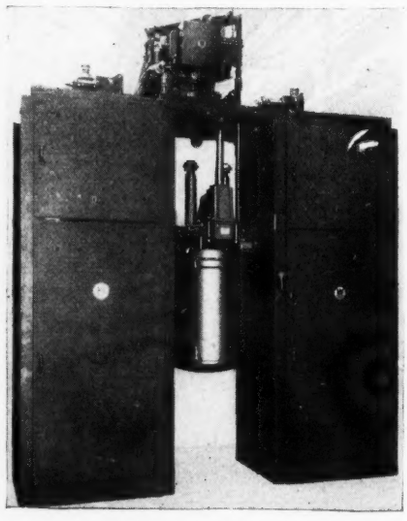
For belt conveyors installed to carry materials that are severe on metal bearings, coke breeze for example, the roller-bearing pulley, pressure greased, as shown in Fig. 2, is used.

In this pulley the labyrinth construction provides a number of closely joined metal surfaces, which prevent powdery abrasives from reaching the bearings. In addition grease under pressure from the inside tends to flow all dirt outward.

Steel Structures for Circuit Breakers

THE usual cell-mounted circuit breaker is placed in a reinforced concrete cell that requires rather skilled workmanship to construct. Time as well as considerable skill and material are required in building the forms. The forms must be properly braced to insure that there is no shifting during the pouring of the concrete. The inserts to be cast into the concrete must be carefully handled to insure that they will be in the proper positions.

The figure shows a circuit breaker mounted in a fabricated steel structure designed to replace the concrete. The circuit breaker, which is a re-



Circuit breaker mounted in a fabricated steel structure

cent product of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is built complete at the factory. The time and expense of installation are materially reduced by using the steel structure because the building of forms, the pouring of the concrete and the cleaning up for installation of apparatus are eliminated.

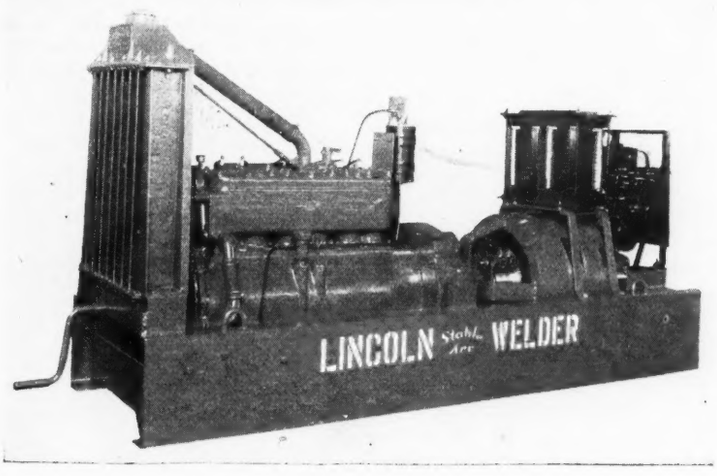
The time of preparing for service is materially reduced because of the unit construction of the apparatus. It is only necessary to put the breaker in place, bolt it down, remove the blocking, check the adjustments, connect it to the control circuits and the busbars, put in the oil, and it is ready for service.

A steel structure is better suited for this service in that the operation of the breaker imposes shocks on the supports. Steel, by its elastic characteristics, absorbs the shocks easily with no damage to itself. Although the structure shown exactly replaces a concrete structure, it is possible to reduce the space occupied by taking advantage of the greater strength of the steel. The steel frame is lighter than the concrete structure, which results in an indirect saving in that the floors and main building can be lightened because of the decreased load carried.

Lincoln Model S-1964 Electric Welder

THE Lincoln Electric Company, Cleveland, Ohio, recently added to its line of welding equipment the 300 - ampere gasoline - engine - driven welder illustrated. The unit, which is known as Model S-1964, is rated at 300 amperes in accordance with N.E.M.A. standards and has a current range of from 75 to 400 amperes for metallic electrode welding. The generator is direct-connected to a six-cylinder Buda Model HS-6 engine, operating at 1,500 r.p.m., both units being mounted on a welded steel base. The engine has an S.A.E. rating of 27.3 hp. and gives a brake horsepower of 41 while running at the operating speed. The gas tank is in the channel-iron frame under the engine, thus eliminating fire hazard.

The generator has the laminated magnetic circuit with separately excited field, stabilizer, variable voltage and steel construction features characteristic of the company's line of "Stable-Arc" welders. The over-all dimensions are 93 in. long, 35 in. wide, with an over-all height of 45 in.

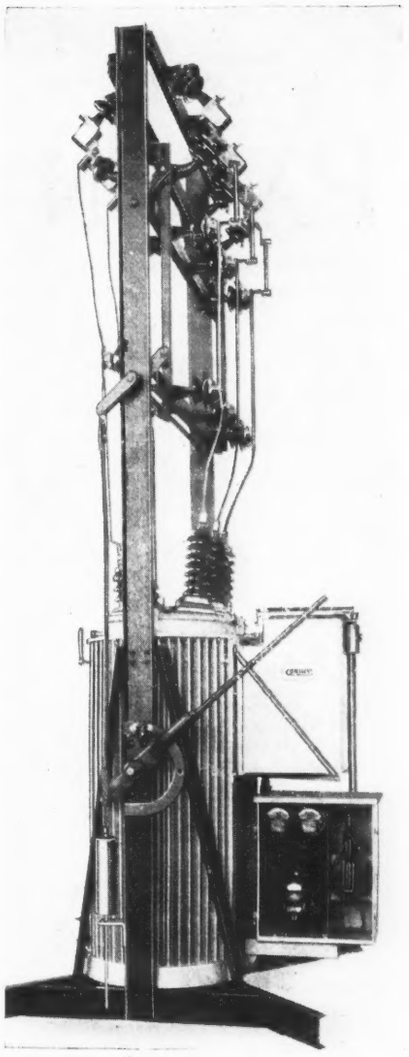


Six-cylinder engine-driven welding unit

Unit Transformer Substation

A NEW way to reduce cost of electric power distribution and at the same time afford increased reliability of operation and safety has been developed by the Condit Electrical Manufacturing Corporation, Boston, Mass. It consists of a new design of substation which in one unit combines a power transformer, switching facilities, overload and short-circuit protection and means of metering, as in the figure.

This achievement has been accomplished by utilizing a standard three-phase star-connected primary-power transformer of the usual design except that it is arranged for inserting an oil circuit breaker in the connections between the primary winding and the common or star-connection point. This oil circuit breaker, because of the transformer reactance, need have a small proportion of the interrupting capacity of an oil circuit breaker on the line side of the transformer. Closing the oil circuit breaker energizes the transformer. Opening this breaker de-energizes both primary and secondary windings. Current transformers suitable for metering and potential transformers are placed within the power transformer compartments.



Transformer, switching and metering equipment

A set of primary and, if desired, secondary disconnects are mounted above the transformer on a simple channel-iron structure integral with it. The disconnects are interlocked to prevent opening except when the oil circuit breaker is open, thereby insuring that neither load current nor magnetizing current can be interrupted on the disconnecting switches.

Protection for the primary leads and windings is afforded by a fuse rated for short circuit only. Overload protection is secured from secondary current transformers energizing trip coils of the oil circuit breaker, causing it to open and de-energize both primary and secondary windings.

The whole structure makes a compact, complete unit substation, resulting in economy of equipment and installation cost combined with ease of operation and maintenance.

Avoiding Infringement of

PATENTED EQUIPMENT

By Leo T. Parker
Attorney at Law, Cincinnati, Ohio

POWER plant operators are confronted daily with perplexing problems concerning the extent of patent monopoly. Common questions often arise, as: May a patented article be manufactured for one's own use and not for purposes of sale, without liability for infringement? What is the dividing line between infringement and non-infringement in repairing a patented device? Are purchasers bound to use patented machinery in accordance with the printed notifications on license plates affixed to the machines? Is a user liable for unintentional infringement? And many other similar questions are asked.

THAT a patent is the most perfect form of monopoly from which profiteering, so to speak, is legalized, has been recognized by the courts since the early case of Wilson vs. Rausseau, 4 Howard 646. Here it was pointed out that a patentee has the exclusive right to *make, sell and use* his invention for the term of years specified in the patent grant.

In Incandescent Cantelo, 12 Pat. Law R. 262, the exceptionally well written opinion of the court explains the rights of a patentee in the following language:

"The patentee has the sole right of making, using and selling the articles, and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them, or dealing in them at all, he has the right to do the lesser thing, that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are."

Thus it is apparent that any person who makes a patented device for his own use is liable for infringement.

Reasons for Patent Laws

Originally, the patent laws were not formulated for the purpose of giving extraordinary advantages to inventors by which they might become rich. The laws were enacted solely to induce persons endowed with the inventive "genius" to exercise this faculty and promote the progress of science, so that the public generally might be benefited by having opportunity of obtaining new and useful things.

However, since the exclusive right to make, use and sell the invention is granted the inventor only a short period, Congress and the courts have endeavored to sustain his enthusiasm and confidence by enacting and upholding the validity of laws that protect him against piratical use of the invention by unauthorized firms. The broadness of these laws not only protects a patentee against piratical firms, but unintentional infringers are liable in damages.

Of course a patent may contain claims so weak that a slight modification of the invention will avoid infringement. This is particularly true where the invention is no more than an unimportant improvement of a well-known and long-used device. However, a basic patent may be sufficiently broad to protect the inventor against any other person or firm making a product even remotely similar. Under these circumstances avoiding infringement is an extremely difficult and hazardous undertaking.

Infringement May Relate to a Single Part

Any person who makes, sells or uses a single part of a patented machine is liable for infringement, if such part is specifically included in the claim of the patent.

In the recent case of General Electric vs. Sutter, 186 Fed. Rep. 639, the court said:

"The legal principles governing contributory infringement exists where one knowingly concerts or acts with another in an unlawful invasion of a patentee's rights. . . . If the part furnished is adapted to other and lawful uses, in addition to infringing uses, then an intent to furnish for infringeing use must be established before the furnisher can be held a contributory infringement."

On the other hand, if a patent specification merely shows and describes several well-known elements *not specifically mentioned in the claims,* any person may make these parts without liability (230 Fed. Rep. 821).

A common source of litigation is where a purchaser of expensive patented equipment attempts to reconstruct or rebuild it without receiving permission to do so from the patentee or assignor of the patent.

The established rule of the law is that the owner of a patented device may make small and necessary repairs without liability for infringement, but if he rebuilds a worn-out machine or replaces a broken part that is specifically protected in the claims of the patent and that is intended to be durable, he is liable for infringement.

Certain kinds of patented machine parts, however, may be replaced by the users without liability for infringement. This phase of the law was discussed by the Supreme Court of the United States in the leading case of T. A. Heyer Duplicator Company vs. Duplicator Manufacture Company, 263 U. S. 100.

The facts of this case are that a patentee sold to a user a costly copying machine dependent for its operation on bands or rollers formed from a well-known common gelatin composition. These rollers frequently required replacement. The patent contained claims which included the gelatin rollers. Controversy developed when users of the machine purchased rollers for replacement purposes from persons other than the patentee. The latter instituted legal proceedings for infringement on the grounds that since the substituted rollers were manufactured especially for use on the patented machines, both the manufacturer and users of the rollers were liable as infringers.

The lower court held that infringement existed, but the Supreme Court reversed this verdict and, in holding the user of the machine not compelled to purchase the gelatin rollers from the patentee, said:

"The main question is whether the purchasers of these machines have a right to replace the gelatin bands from any source that they choose. The machine lasts indefinitely, the bands are exhausted after a limited use and manifestly must be replaced. The machine is costly, the bands are a cheap and common article of commerce."

It is quite apparent that parts that are known to require frequent replacements, caused by wear, may be substituted by the user of a patented machine without liability for infringement. If, however, the parts are known to be frequently removable from a patented machine, not by

necessity of wear, then the user may not make the substitution without liability.

Many patented machines contain license plates on which are printed certain restrictions of the uses of patented devices.

It is interesting to observe that in Chaffee vs. Boston Belting Company, 22 Howard 217, the law was established and upheld by the Supreme Court (229 U. S. 18), as follows:

"When the patented machine rightfully passes to the hands of the purchaser from the patentee, or from any other person by him authorized to convey it, the machine is no longer within the limits of the monopoly . . . it then passes outside of monopoly, and is no longer under the peculiar protection granted to patented rights. By a valid sale and purchase, the patented machine becomes the private individual property of the purchaser, and is no longer protected by the laws of the United States, but by the laws of the state in which it is situated. Hence, it is obvious, that if a person legally acquires a title to that which is the subject of letters patent, he may continue to use it until it is worn out, or he may repair it or improve upon it, as he pleases, in the same manner as if dealing with property of any other kind."

Therefore, where a patentee sells a patented device, he has absolutely no control over the use of the machine by a purchaser. The fact that he attaches a plate to the machine or notifies the purchaser after the sale is completed that he must use it only in a restricted manner, is unimportant and positively *not* binding on the purchaser. (243 U. S. 502.)

On the other hand, if a patentee licenses a patented machine to a power-plant operator, the latter is bound by the license contract provided it does not conflict with the anti-trust laws. But the license must not be a disguised sale, or the agreement is void and non-enforceable.

Unintentional Infringer

It is immaterial that a person is an infringer of a patent in good faith and innocently or for bad purposes and unintentionally. The infringement exists under both circumstances.

The law is established that a firm or person who deliberately and purposely infringes a patented invention is liable for *three* times the actual damages caused the patentee plus three times the earned profits. But an unintentional or innocent infringer may be liable for *only* the actual earned profits, and the damages effected the patentee.

Although a firm purchases a machine from a seller believing the latter holds patent rights, the former is liable for infringement for using the device, if it later develops that the seller is an infringer.

Patentee not Bound to Sell Invention

At various times persons have subjected themselves to prosecution for infringement while acting on the belief that if a patentee refuses to make and sell his invention and will not grant a license to another to do so, any person is privileged to make and use the invention without liability. This is not true.

In Heaton Peninsular Company vs. Eureka Specialty Company, 47 U. S. 146, the Supreme Court held as follows:

"If he (patentee) sees fit, he may reserve to himself the exclusive use of his invention or discovery. If he will neither use his device nor permit others to use it, he has but suppressed his own. . . . A suppression can endure but for the life of the patent, and the disclosure he has made will enable all to enjoy the fruit of his genius. His title is exclusive and so clearly within the constitutional provisions in respect of private property that *he is neither bound to use his discovery himself nor permit others to use it.*"

Saving Heat Units in the Plant

By Joseph W. Hays

Mid-Continent Petroleum Corporation, Tulsa, Oklahoma

WHY should a specialist of any kind be assigned the job of caring for the heat units? Is there any particular mystery in the "trade" of the combustion engineer? The trouble is that the process men, and the mechanical men who serve them, are so deep in the woods of operating details that they cannot see the forest because of the trees that surround them. Their noses are so close to the printed page that they are unable to see what everybody else can read. One can get so accustomed to an obvious waste that he will cease to observe it.

If you would stop wastes in a refinery, you must make it the business of some competent person to hunt them out, measure them and devise practicable means of putting an end to them—otherwise the wastes will wait and flourish until somebody thinks he has time to concern himself with them. Here is a job for the combustion engineer. He will need a staff to assist him. He will not have to go out of the refinery for his staff and should not do so. He can make use of men already on the payrolls and, without changing their duties materially, organize and co-ordinate their efforts in a comprehensive campaign to stop preventable waste. This staff should include all the instrument men, test engineers and others whose business it is to collect exact data relating to operating costs and wastes. The men must be educated as well as organized. These things take time. Furthermore, the men who are to assist in this war on waste must be acquainted with all the principal operations and with the operators, especially the heads of departments. It will not be necessary, as a rule, to replace any of these men on assigning them to the combustion engineer's department. The size of the staff required will depend on the size of the job—the size of the refinery.

This paper, on "The Rôle of the Combustion Engineer in Refining," was read by Mr. Hays at the February, 1928, meeting of the American Institute of Mining and Metallurgical Engineers, in New York. The author who, in referring to "combustion engineers," means what "Power" ordinarily calls power engineers, has some interesting suggestions to make as to the importance of heat saving in the industrial plant and how to go about it.

This department will check all processes to detect wastes, have charge of all tests except those properly coming within the province of the laboratories, and do such research work as may be permitted in the development of improvements in heat processes. The combustion engineer and his department should not be under the jurisdiction of any refinery head. This is on the sound theory that the men who are doing the checking should not be under the control of the men who are being checked. The department should be under the control of the highest official responsible for the refinery and should take orders from no one else.

Whatever the department gathers in the way of information likely to prove useful to the mechanical or process departments and, above all, to the superintendent of the refinery, must be open and available to them at all times. The combustion engineer must work out some general and comprehensive plan of campaign for his department. His job is:

1. To find out what should be done, where when and how to do it. His

previous experience will indicate, in a general way, his points of attack.

2. To get authority to have it done; which is some job sometimes, especially if it involves the expenditure of money.

3. To get it done. Someone has said that plan is 10 per cent and execution 90 per cent.

4. To keep it done. It is one thing to get efficiency and another thing to maintain it.

Any good combustion engineer can produce some results in a refinery, but if he lays the proper groundwork for a thorough campaign to take in the entire plant, if he is then given the necessary organization to carry on that campaign and if he has the full confidence and cooperation of all the heads of departments, including the accounting department, he can produce results that should be strikingly apparent on the balance sheets of the company.

Planning the Campaign

It would not be advisable here to be very specific as to the details of the organization and of the campaign itself. Each refinery is a problem in itself and must be studied carefully before the plans are made. The plans must be suited to the case, otherwise they will fail. The combustion engineer and his staff must be able, not only to obtain exact information, digest it and arrive at sound conclusions, but also to present reports and recommendations in complete, concise and convincing form. It will all amount to nothing unless somebody authorizes action.

It is not always easy to get action after it has been authorized. Nothing must interfere with the operation of the refinery. Improvements and changes must be made when the stills or other equipment can be spared long enough to permit installation. It is idle to think about making them at any other time. For this reason and for many others the combustion engineer must keep in touch with operation and have his plans matured in advance if he expects to make any changes in the regular equipment.

It is one thing to get efficiency and quite another thing to maintain it. Efficiency when somebody is present, watching every move that is made, is not so difficult to obtain. But to be sure of efficiency when the operators are alone with their stills and their consciences, is quite another matter. Several things are necessary if the plant is to be operated continuously on the best basis of economy. There must be instruments to measure the consumption of fuel and of all of the utilities, in whole and as distributed. All operations must be standardized as far as possible. Refinery operations are standardized in the sense that the steps necessary to be taken to produce given products from given stocks are well known and practiced. In many cases they are not standardized with reference to the best methods of producing the maximum of output at the minimum of cost.

It is easy to standardize operations in a steam boiler plant. The boilers and furnaces must be in good physical condition. The water must be treated and tested. Certain drafts must be employed. The fuel must be burned with a certain excess of air. The boilers must be worked at a certain capacity, etc. Instruments are available to check up every step of the steam-producing operation. It is therefore possible to tell the boiler-house operatives today how much they wasted yesterday and which of them were responsible for the waste. Maintaining efficiency thus becomes a matter of constant watchfulness. The moment you cease to watch the daily reports, the operatives themselves cease to be watchful. You will bear in mind that I am here speaking of steam boiler plants only, and that it is generally admitted the average run of such plants waste at least one-quarter of the fuel burned. Often the waste of fuel is substantially more than twenty-five per cent.

But when we are undertaking a betterment campaign in an oil refinery, we find ourselves facing a maze of difficulties the moment we leave the boiler houses. If we try to tell a still foreman how much heat his crew wasted yesterday, we may have some difficulty in convincing either him or ourselves that our figures are correct. We must be sure of our proofs before we make charges against anybody.

No Overlapping

There is no overlapping of processes in the boiler room. There is just one process, that of turning water into steam at a certain pressure. But the processes of refining oil overlap and blend themselves one into another. Furthermore, particularly in batch still operations, there are pronounced peaks in the cycles. If you make a curve representing a batch still cycle today, you may have to make another one tomorrow, because you may find that a different stock is being run to a different gravity of bottoms. In most refineries the stills are exposed to the weather, which is subject to changes. Winds, generally speaking, affect the efficiency of still operation more than rain and rain more than falling temperature. All these things must be evaluated as far as possible before we can set up standards by which to measure the efficiency of a process operation. And until we can measure the efficiency of an operator in terms of dollars and cents wasted, and prove it, we need not expect the man to go against human nature and exert himself to as full an extent as he otherwise might.

An efficiency campaign is so much worth-while in a refinery that it is a mistake to go about it in a half-hearted or half-prepared manner. In planning his campaign the combustion engineer must think of the refinery as a whole. He must be able to see the relations of the several departments and processes and that there is a degree of interdependence which he is not in the habit of finding in other kinds of industrial plants. If he can get the right point of view with respect to the very complex problems before him; if he is accorded the assistance that he requires and if he meets with cheerful co-operation by all foremen and heads of departments, he can produce results that will surprise and gratify everybody. With everything that I can think of in his favor, he will still find that he has "one whale of a job" before him. As a result of my studies in the oil-refining field I have listed more than 100 separate and distinct trails that the combustion engineer may find and follow in his search for lost heat units.

May one have a vision of the future and escape the charge of being visionary? Let us try looking ahead a little. Petroleum is composed of hydrocarbons, the most complex compounds known to the chemist. Salt water is the curse of the oil fields. The brines carry the chlorides of sodium, calcium and magnesium. They also carry bromine and iodine. They therefore carry some of the basic materials of the chemical industry. To produce these chemicals from oil-field brine, heat and electricity are necessary. Refineries waste huge quantities of the one and can produce huge quantities of the other at almost no cost at all. Steam is needed for process work. It could be produced at high pressure and stepped down to the pressure requirements of the service lines through turbine or engines acting as "reducing valves," the actual cost of the current under such circumstances being reduced relatively near to the vanishing point. To produce caustic soda, of which huge quantities are used in the refining industry, salt water, heat and electricity are required. Chlorine is produced as a byproduct and chlorine is used in the industry.

Utilizing Oil-Field Brine

Do we find the oil industry utilizing its brine? Yes. It provides a fine basis for damage suits and helps to keep the legal departments busy. Oil men swear at the salt water and haul their caustic soda, which could be produced on the refinery grounds, a thousand miles or more in some cases, from the big chemical plants in the North. "Ethyl" has stimulated a great demand for bromine. Efforts have been made to extract it on a commercial scale from sea water. Some of the brines of the Mid-Continent field have almost ten times the bromine content of sea water. Refineries burn residue gases that would have almost unbelievable values if combined with some of the chemicals that can be extracted from oil-field brine. It would not be difficult to show that a barrel of oil-field brine actually carries more possibilities of value than a barrel of crude oil.

The oil industry, like the meat industry, will find that its largest profits are in its byproducts derived from its wastes. The refinery of the future will have a chemical plant as an adjunct. The tail may wag the dog; I do not know. I do know that the combustion engineer will have his part to play in these things as they are brought about. Much research and development work must be done before I can point you to a realization of this vision.

RECENT PUBLICATIONS

A STUDY OF SPONTANEOUS COMBUSTION IN STORAGE COAL. By A. J. Hoskin. Bulletin No. 30, Engineering Experiment Station, Purdue University, Lafayette, Ind., 1928. 61 pages.

THIS bulletin is a summation and evaluation of the published data on spontaneous combustion in outdoor coal-storage piles. It is concerned particularly with Indiana coals and conditions encountered in that state. However, there is almost as much of value in the booklet for bituminous coal users located elsewhere as for residents of Indiana.

It is the author's conclusion, based on his study, that producers, dealers and large consumers of bituminous coal may today so profit from the experiences of former coal storers and from the findings of scientific research as to feel reasonable assurance against the hazard in their future storages.

The work points out that standardization in coal storage has not been accomplished or even attempted. The benefits of such a practice wait upon agreement as to the true fundamentals of safe coal storage. Such agreement is delayed by the fact that there are many systems in use that give fairly satisfactory results and that fires in coal piles are comparatively rare exceptions, anyway. Also, scientific investigators so far have failed to agree in the advice they offer.

FINANCIAL AND BUSINESS FORECASTING —The Basic Business Cycle Thesis Explained, and the Art of Forecasting Discussed Without the Use of Higher Mathematics. By Dr. Warren F. Hickernell, Alexander Hamilton Institute, New York. Two volumes. Cloth; 5½x8½ in.; 914 pp. Price, $10 for both volumes.

TO THE business man and manufacturing executive who wishes to possess a working knowledge of the basic theories of the business cycle minus the all too familiar perplexing mathematical formulas; a quick though vivid view of the waves of prosperity and of over-speculation, which have characterized the course of business in the United States and Europe for more than a century past; and finally the basic methods now in use in financial analysis and forecasting, this two-volume publication, by Doctor Hickernell, will prove interesting and enlightening. The cyclic theories of Mills, Jevon, Moore, Juglar and Mitchell are explained in a simple manner, and their strength and weaknesses pointed out. Many business men believe that the business cycle, with all its attendant evils, is inevitable, just one of those things in life which have been ordained in the very nature of things and for which there is no positive cure. While admitting that this belief has considerable foundation, based on the ups and downs of the past four centuries, yet the fact is made clear that there are cures for such cycles of wide variation in business and industrial activities, and a smoothing of the business cycle is even now being applied. History is generously used to explain the basic reasons for these decided fluctuations of the past.

Doctor Hickernell accordingly devotes his second volume to a study of financial analysis and forecasting, bringing out the fact that the four symbols of forecasting are: (1) Basic business statistics; (2) a knowledge of economic principles; (3) prospective, based on a study of business history; (4) good judgment in applying principles to the interpretation of statistics. It is necessary to study individual commodities, individual securities and local business conditions, as well as the general trend of business.

SAFETY AND PRODUCTION. An Engineering and Statistical Study of the Relationship Between Industrial Safety and Production. A Report by the American Engineering Council. Harper & Bros., New York, 1928. 414 pages. Price, $5.

THIS study was carried out at the instance of the National Bureau of Casualty and Surety Underwriters and was under the direction of J. E. Hannum, of the Eye Sight Conservation Council of America. The inception of the study lay in a peculiar phenomenon noticed since the War. Although the general trend of the accident mortality rate has been downward since the start of the organized safety movement, there has been an increase in these last years in the number and severity of accidents.

The study was directed primarily to a determination of the relation between industrial safety and efficiency of production. It was thought that the situation indicated no breakdown in the safety movement, but was rather a result of the increased intensity of modern industrial life. This increased activity requires the employment of new, inexperienced men and the shifting of old men to new jobs. It also requires a vastly greater mechanization, with a corresponding increase in the liability to accidents, though such accidents may not be as severe. The hazard per worker, in a mechanized industry, because of the relatively fewer workers, is greater.

The actual situation seems to be fewer accidents measured in terms of things produced, but more production, so that the result is, after all, more accidents.

The study was based on this thesis and sought to determine how accidents can be controlled under the new industrial conditions. For working purposes the thesis was restated as follows: Safety in the factory and efficiency of production are both aspects of good executive control, and a right organization in industry will, with proper managerial effort, bring about both efficient and safe production, and that neither can be satisfactorily achieved by itself alone.

The study covered many plants in various industries, including cement, chemicals, coal mining, coke, electric power, electric railway, gas, iron and steel, machine and metal working, mineral mining, paper and pulp, quarrying, steam railways, telephone and telegraph, textiles, and wood working.

As a result of the study it is stated that, in general, if American industrialists will adopt the same executive policy toward safety that they have fully developed toward production, a decreasing number of deaths, permanent disabilities and temporary disabilities may be confidently expected.

For its wealth of detailed statistics, its broad and instructive treatment of the accident situation, and its pertinent conclusions thereon, this report is sincerely recommended for perusal by all engineers upon whom rests responsibility for the safety of workers.

EFFECT OF STRATIFICATION OF FURNACE GASES ON STEAM BOILER LOSSES. By F. W. Marquis, Paul Bucher and H. M. Faust. Bulletin No. 34, Engineering Series, Ohio State University, Columbus, Ohio, 1927. 82 pages.

THREE series of tests, two on a 6,000-sq.ft. B. & W. cross-drum boiler equipped with a Harrington stoker and one on a 1,070-sq.ft. B. & W. longitudinal-drum boiler, equipped with a Model stoker, are reported in this publication. These tests developed the fact that poor mixing and stratification of the gases in a furnace cause a marked decrease in efficiency with a resultant decrease in capacity. For these and other reasons discussed in the bulletin, great care and considerable expense for design and construction of furnaces, to insure good mixing, are justified. Two appendices give the test data and the methods of making all calculations.

WATER-POWER YEAR BOOK 1927-28. Published by Richard Pflaum, Druckerei-und Verlags A.-G., Munchen, Germany. Cloth; 9 x 6½ in.; 458 pages; illustrated. Price, $5.

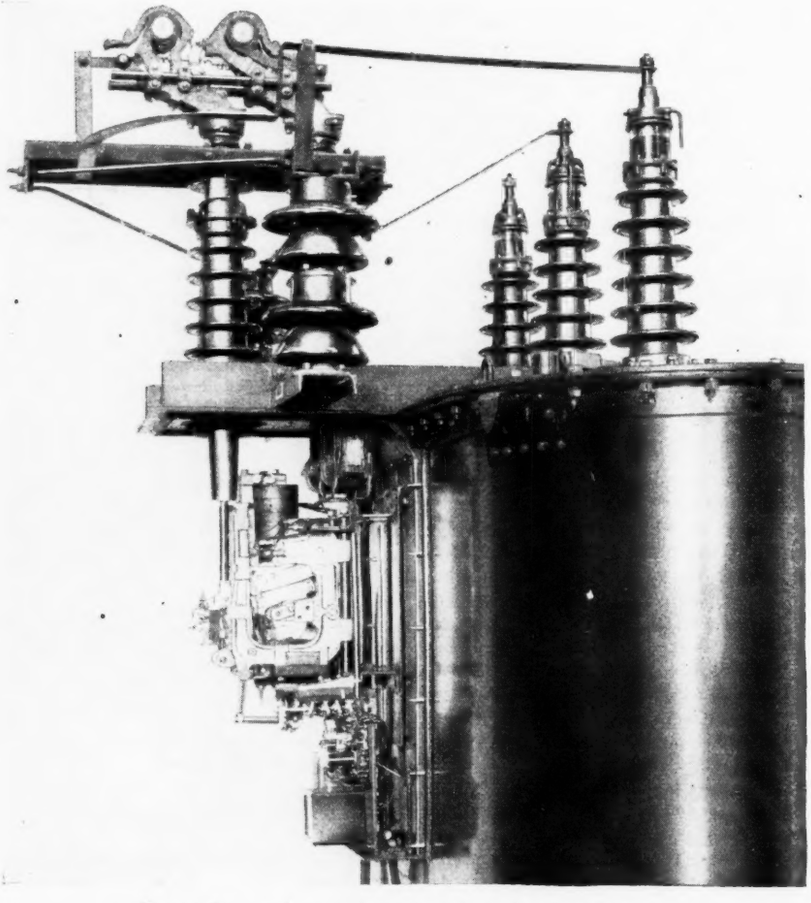
THIS book comprises five sections, the first of which contains ten articles on water-power development in different European countries. The second section has ten articles on different classes of hydro-electric developments and their operation. Five articles on problems in water-power construction comprise section three. These articles deal with such subjects as landscaping and geological formations. In section four there are seven articles on water-power machinery. One of these is a study of different types of draft tubes and another on Kaplin type turbines. An article in section five deals with the design of low-head plants and includes a table giving the important dimensions for nine large low-head plants in the United States and Europe.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Direct-Current Transmission Approximated with Alternating Current

TRANSMISSION characteristics closely approaching those of high-voltage direct current were realized for the first time recently with the installation by the General Electric Company of three series capacitors (static condensers) on a tie-line operated by the New York Power & Light Corporation at Ballston Spa, N. Y. The capacitors, connected directly in series with a 33,000-volt 7,500-kva. line running from Amsterdam to Ballston substation, compensate completely for transformer and line reactance at all loads. The electrical effect is said to be equivalent to placing the Ballston substation in the yard of the Amsterdam generating station twenty miles away.



Protective equipment is mounted on the capacitators

The electrical profession has long realized that direct-current transmission at high voltages would give ideal performance characteristics and would permit large amounts of power to be sent over long distances at an expense far less than for alternating current. Direct current, however, cannot be generated or utilized successfully at high voltage, and there has never been available a device that could economically perform the transformation in voltage that would be required if high-tension direct-current transmission were to be used with low-voltage generators and load. The series capacitor, however, is a solution of the problem from another angle, for, instead of making direct-current transmission possible, it has eliminated some of the most serious limitations of alternating-current transmission. The series capacitor does this by nullifying the reactance of the transmission line and of the equipment interposed in the line, such as transformers, etc.

The problem of compensation for reactance drop has been attacked at various times by transmission engineers, but up to the time of the present installation, no effort on a commercial scale has been made to insert capacitance in series with the line carrying the load current. The installation, which has been in continuous operation since February of this year, has shown that it is entirely feasible to transmit power through the dielectric of the capacitor units. Automatic protective equipment is included, which has proved successful in meeting all conditions of switching, short-circuit and lightning so far encountered.

The installation consists of three single-phase capacitors, each rated 415 kva. 3,170 volts 132 amperes 60 cycles. Each capacitor is mounted in an oil-filled tank and is complete and self-contained. The automatic protective equipment is designed to bypass the unit during short-circuit conditions and to restore the line connections when normal conditions are resumed.

The protective equipment consists of a sphere gap connected across each capacitor, combined with a high-speed contactor which automatically closes in case of a flash-over of the protective gap. The entire mechanism is mounted in two steel cabinets supported upon the tank structure.

The series capacitor itself consists of a group of capacitor units mounted in three tiers upon a steel framework. This framework rests upon insulators, and the whole is immersed in oil.

American Engineers Present Clock and Carillon to Louvain University

Engineering was extolled as the dominating force of the modern world in an address of the War Memorial Committee of American Engineers formally presenting to the University of Louvain on July 4 a clock and carillon costing $80,000 for the Tower of the new Library Building. The ceremony took place in connection with the dedication of the Library.

The address, in French, and signed by all the members of the committee, was handed to the secretary of the University, Leon Van der Essen, by Dr. Edward Dean Adams, of New York, chairman of the committee and representative of the Engineering Foundation.

Secretary Van der Essen read the ad-

dress, which recited that "To the glory of God and in memory of their fellow engineers who died in service during the Great War 1914-1918, engineering societies of the United States of America present to the University of Louvain, the carillon and the clock installed in the Tower of the Library of the University, the endowment fund of $10,000 for their maintenance, the Honor Roll of those who died, and a record of the names of all those whose contributions have made this memorial possible."

The ceremony included the delivery of the deed of gift and trust by Arthur W. Berresford, of New York, president of the American Engineering Council, and of a Memorial Record Volume containing the Honor Roll, description of the carillon, the clock and other parts of the engineers' memorial, and a list of contributors to the fund, by Alfred D. Flinn of New York, Director of the Engineering Foundation.

Col. Arthur S. Dwight, of New York, on behalf of the War Memorial Committee, presented to Louvain two flags, one bearing the insignia of the American Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers, and the other that of the Society of American Military Engineers. The concluding event of the exercises was the presentation by Major L. R. Lohr, of Washington, D. C., of a silk regimental flag of the United States.

Another enginering event of Independence Day at Louvain was the unveiling in the Library Building of a bronze bust of Herbert Hoover "in recognition of his humanitarian services to Belgium during the War and since."

On the morning of July 4 the visiting American engineers and their wives were the guests of the Association of Graduate Engineers of the University of Louvain. After a sightseeing trip at Louvain the engineers inspected the new engineering schools at d'Heverle Park, where luncheon was served.

In the evening at a banquet attended by engineers and others at the dedication ceremonies, Chevalier Josef Denyn, called the dean of carillonneurs, played a concert on the new Louvain carillon.

Railway Substation Gets Mercury Rectifier

An automatic electric substation with a 500-kw. mercury arc rectifier is being installed by the Chicago & Joliet Electric Railway at Lemont, Ill. It supplants equipment that has been used there since 1901 and provides for transforming 32,000-volt alternating current purchased from the Public Service Company, to 600-volt direct current for operation of its electric line. The new installation will eliminate employment of two operators and maintenance of two service lines between Joliet and Summit. G. K. Gibbon, Schenectady, N. Y., engineer, is preparing the plans and will be in charge of installation, which is to be completed by August 1.

Heating and Ventilating Engineers Gather at West Baden for Summer Meeting

THE 34th semi-annual meeting of the American Society of Heating and Ventilating Engineers, held at West Baden Springs Hotel, West Baden, Ind., June 26-29, was conceded by all to have been one of the best summer meetings yet held by the Society. Two hundred forty-six members and guests participated in the spirited proceedings and enjoyed the hospitality of the Indiana members, who presided as hosts to the gathering.

Eighteen technical papers, covering many phases of the heating and ventilating industry, delivered by professors and engineers, featured the four daily technical sessions, while golf and tennis tournaments, horseback riding and sightseeing, with nightly dances and receptions, more than balanced the strenuous business program.

The opening technical session was called to order by president A. C. Willard, University of Illinois, Urbana, who extended a hearty welcome to all present. An announcement followed that the Indiana members had petitioned the Council for a state charter, which, prior to adjournment of the meeting, was granted to the enthusiastic Hoosiers. The new chapter will make its headquarters at Indianapolis.

W. E. Stark, engineer, Bryant Heater & Manufacturing Company, Cleveland, next presented a paper on "Development of Gas Heating for Homes," in which present-day attainments and future possibilities of gas heating were cited. According to Mr. Stark gas as a heating fuel has its best days ahead of it. In his opinion economic pressure and the increasing demand for unpolluted atmosphere are among the many factors that will bring about the extensive acceptance of gas as a building-heating medium.

During the discussion that followed Mr. Stark's remarks, it was pointed out that due care must be taken in selecting proper-sized boilers where gas fuel is to be used, and it was stressed that chimney draft on gas-burning appliances must vent successfully to attain maximum efficiency.

A treatise on "Method of Calculating Cost of Gas Heating" was tendered by A. E. Stacey, research engineer, Carrier Engineering Corporation, Newark, N. J. With the aid of slides the complex elements encountered in various parts of the country in calculating cost of gas heating were explained, and it was suggested that where gas is to be used for home heating, best results can be obtained by building houses with smaller flues, especially designed for gas fuel.

Much interest was taken in a paper on "Operating Data on Federal Buildings," prepared by Nelson Thompson, chief mechanical and electrical engineer, United States Treasury Department, Washington, D. C. In this paper data concerning the operation of the mechanical equipment in 1,400 buildings under control of the Treasury Department were given.

Those present agreed that the data were of inestimable value, because of their application to the maintenance of large commercial buildings, hotels and apartment houses.

A paper on "Heating Industrial Buildings with Warm Air," ably delivered by J. C. Miles, vice-president of the Warm Air Furnace Company, Cleveland, which claimed that this method of heating reduced losses to a minimum, was favorably received by the gathering.

"Relative Consumption of Various Solid Fuels in Residence Heating" was the subject of a technical paper prepared by V. S. Day, research associate, University of Illinois, in which comparisons the relative economy of six distinct classes of solid fuels was clearly pointed out.

The need for a new type of furnace that will efficiently burn soft coal was stressed and the Society was urged to adopt methods of educating the public to the proper handling and use of various types of heating equipment.

A concise paper on the "Design and Performance of Domestic Oil Burners," prepared by W. C. McTarnahan, president, Petroleum Heat & Power Company, New York City, and chairman of the Research Committee, American Oil Burner Association, created much interest. It was stated that the article contained the first authentic data on oil burners offered to the Society.

In the discussion of this paper it was the consensus of opinion that there should be a closer co-operation among the engineers, heating contractors and the oil-burner manufacturers; it being the belief that many oil burners are not designed to handle the required load properly.

The results of co-operative study of heat transfer, under natural weather conditions and through a roof, under summer conditions, furnished the subject of two papers prepared by F. C. Houghton, director, and C. G. F. Zobel, research physicist, of the A.S.H.&V.E. Laboratory, Pittsburgh. Professor Houghton explained the coefficients of heat transfer as measured under natural weather conditions, and Mr. Zobel handled the subject of heat transfer through roofs under summer conditions.

On Thursday morning "Heat Transmission Research" was the first topic of discussion. The findings of Professors F. B. Rowley, F. M. Morris and A. B. Algren, University of Minnesota, Minneapolis, were presented by Professor Rowley.

Possibly the most vigorously discussed subject brought before the meeting was the report of the Committee on Rating and Selection of Low-Pressure Heating Boilers. In the absence of Chairman Alfred Kellogg, Samuel R. Lewis read

the committee's recommendations and pleaded for their adoption.

Much difference of opinion was expressed as to the practicability of the proposed code, it being pointed out that any code adopted by the organization must be acceptable to the manufacturers. It was suggested that the code should treat house-heating boilers separately from large-type boilers, and Dean Anderson proposed a code for testing boilers in lieu of selection. It was his opinion that the Society would be establishing a dangerous precedent by adopting a code of selection. After considerable discussion a motion was carried referring it back to the committee for further consideration.

The report of the Committee on Heating and Ventilating Garages was tendered by E. K. Campbell. It was stated that the report had been prepared in collaboration with the National Fire Protection Association and had as its basic principles a tentative standard for a fire protection code. The report was tentatively approved.

The results of a study of dust determinators, made by Professors Frank B. Rowley and John Beal, University of Minnesota, were explained by Professor Rowley, after which the rest of the session was given over to L. L. Lewis, secretary of the Carrier Engineering Corporation, for a technical discussion of "Methods of Air Distribution."

The final session, which convened Friday morning, featured five constructive and educational lectures. "Refrigeration as Applied to Air Conditioning," handled by R. W. Waterfill, refrigerating engineer, Carrier Engineer Corporation, came first on the program, after which "Air Leakage Through a Pivoted Metal Window," by Professors F. C. Houghton and M. E. O'Connell, of the Research Laboratory; "The Weathertightness of Rolled Section Steel Windows," by Prof. J. E. Emswiller, University of Michigan, and W. C. Randall, chief engineer Detroit Steel Products Company, Detroit; "Effect of Frame Calking and Storm Windows on Infiltration Around and Through Windows," by Professors W. M. Richtmann and C. Braatz, University of Wisconsin, and "Heating and Ventilating Problems of Gas Cell Manufacture for Air-ships," by D. E. Humphrey, engineer, Goodyear Tire & Rubber Company, Akron, Ohio, followed in consecutive order.

New England N.A.P.E. Meet at Hartford

With a registration of about two hundred delegates, guests and exhibitors, the New England States Association of the National Association of Power Engineers held its Sixteenth Annual Convention at Hartford, Conn., June 21 to 23. The meetings were held in the old Foot Guard Armory, together with the exhibits of power-plant equipment.

At the opening session on Tuesday evening, Mayor W. E. Batterson of Hartford welcomed the engineers and called attention to the increasing prominence of the engineering profession, citing the nomination of Herbert Hoover to show the recognition of engineers in public affairs. Other speakers of the evening were: T. W. Laiman, chairman of the Convention Committee; President Freeman Tyler of the New England Association, W. H. Corbin, who spoke for the Hartford Chamber of Commerce, and Elmer S. Bassett, National President of the N.A.P.E. The speakers were followed by an illustrated lecture on the mercury boiler now being erected at the South Meadow Station of the Hartford Electric Light Company. A brief entertainment closed the evening's program.

The reports of the various committees took up the Friday session, at the close of which the following officers were elected for the ensuing year: President, John A. Babstram, of Fitchburg; vice-president, Arthur Ford; secretary, Karl B. Powers; treasurer, Walter H. Damon; conductor, P. H. Hanson; door keeper, J. L. Anderson. Fitchburg was chosen as the place for next year's convention.

Coincident with the closure of the New England States Association Meeting, the Connecticut States Association opened its convention on Friday evening, and on Saturday both groups made an inspection trip through the South Meadow Station of the Hartford Electric Light Company, after which a visit was made to Brainard Field for luncheon, an inspection of equipment, and airplane flights.

Coming Conventions

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-26; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

New England Water Works Association, annual convention at Montreal, Canada, Sept. 18-21, Frank J. Gifford, secretary, 715 Tremont Temple, Boston, Mass.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Quebec Government Regulation Increases the Power of St. Maurice River

The recent sale of water-power rights on the St. Maurice River by the Quebec government to the Shawinigan Water & Power Company directs attention to the influence this river is exerting on the industrial prosperity of the province and to the power possibilities of the stream. The area around the mouth of the St. Maurice is one of the highly industrialized sections in Canada. The pulp and paper mills at Three Rivers, Cap Madeleine, Shawinigan and Grand' Mere are capable of producing something like 2,600 tons of newsprint per day, or 30 per cent of the installed capacity of the newsprint mills of Canada. These mills now require in the neighborhood of 200,000 hp. of electric energy.

Next in importance in the utilization of power is the group of electrochemical industries centered at Shawinigan Falls, industries requiring large amounts of power for operation of electric furnaces having located close to the point of generation. An aluminum industry uses 50,000 hp.; in the manufacture of calcium carbide over 30,000 hp. is used, and there is a carborundum industry using 12,000 hp. In addition to all these large requirements and the numerous smaller power using industries, the St. Maurice River supplies in the neighborhood of 100,000 hp. for distribution at Montreal and surrounding territory.

In 1902 there were only two units in operation on the St. Maurice River, each capable of delivering 5,000 hp. Today the power houses at Shawinigan Falls, Grand'Mere and La Gabelle are capable of delivering over 550,000 hp., and there is reported to be approximately 150,000 hp. yet available at these points. All this power is concentrated in a twelve-mile stretch of the St. Maurice River, whose waters fall 250 ft. in this section.

The Shawinigan company is reported to be planning to develop another stretch of this power stream. At the three sites recently taken over by the company there is, according to the provincial hydro service, over 300,000 hp. available. The company is required to spend about $25,000,000 in developing these sites. Actually, the expenditure will run several times this figure before all power is developed.

One of the principal reasons why the St. Maurice River is so productive of power is that the Quebec government has adopted a policy of erecting control works at different points. Chief among these is the world famous Gouin dam, creating a reservoir constituting the second largest artificially created lake storage in the world. The Gouin dam holds back 160 billion cubic feet of water, reserving spring freshets to be fed through the turbines as required. With other regulating dams on the Nanouan River, a tributary of the St. Maurice, the Quebec Streams Commission is now regulating the discharge at 16,500 cu.ft. per sec. Previous to con-

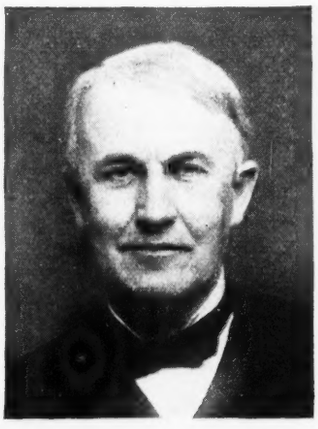
trol, the minimum was around 6,000 cu.ft. per second.

What has been accomplished on the St. Maurice River is being duplicated in numerous other places throughout Canada, the building of the Bitobee dam on the Gatineau River, also by the Quebec government, being another excellent example of what can be done with the streams of the Laurentian Mountains.

Honorary Members Elected by A. I. E. E.

Five distinguished American engineers were elected honorary members of the American Institute of Electrical Engineers at a meeting of its Board of Directors held during the annual summer Convention of the Institute in Denver, June 27. The men thus honored were: Thomas A. Edison, John J. Carty, Michael I. Pupin, Ambrose Swasey, Elihu Thomson.

This is the first time in history that any American honorary members have been elected; previously, the Institute had a few foreign honorary members, but it was recently decided by the Directors to add to the Honorary Membership List a few outstanding



Thomas A. Edison

American engineers, and the five named having been nominated in each case by a petition of ten or more members of the Institute, they were elected by the unanimous vote of the 26 members of the Board of Directors located in various parts of the United States and Canada, this unanimous vote being one of the requirements of the constitution in order to effect the election of an honorary member.

Thomas A. Edison, known throughout the world for his achievements, was born at Milan, Ohio, in 1847. His first affiliation with the electrical field was as a telegraph operator, to which art he contributed the automatic repeater, quadruplex and printing telegraphs. He is the father of the incandescent lamp. His numerous inventions have included the carbon telephone transmitter, megaphone and phonograph. During the World War Edison served as president of the Naval Consulting Board.

John J. Carty, telephone pioneer and inventor, leader in the development of telephone communication, has been continually associated with the telephone industry since 1879. He was formerly chief engineer and is now a vice-president of the American Telephone & Telegraph Company. During the War Mr. Carty rendered notable service in assembling from telephone personnel, twelve battalions of Signal Corps Troops, and was promoted to the rank of brigadier general in recognition of

John J. Carty

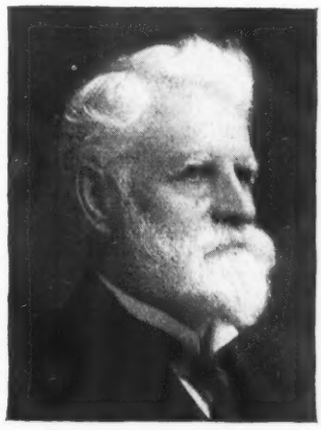
his work in France during and after the War. He was president of the American Institute of Electrical Engineers during 1915-16 and Edison medallist of 1917.

Dr. Michael I. Pupin, professor of electro-mechanics at Columbia University, noted author, lecturer, scientist and inventor, was born in 1858 in Idvor, Serbia. Doctor Pupin's study of electrical wave transmission over long conductors, eventually leading to the

Michael I. Pupin

development of the Pupin coil in 1901 and making voice transmission over long cables successful, is his best-known accomplishment. Among many other honors he is an Edison medalist. He was president of the American Institute of Electrical Engineers in 1925-26.

Ambrose Swasey, famous manufacturer of precision instruments and



Ambrose Swasey

mechanisms, was born in 1846. During the World War Mr. Swasey's firm solved many problems arising in the use of optical instruments, including those necessary for modern fire control

Elihu Thomson

of guns. He is an honorary member of the British Institutions of both Mechanical and Mining Engineers, as well as the Society of Civil Engineers of France, and is a past-president and honorary member of the American Society of Mechanical Engineers. He contributed a half-million dollars to Engineering Foundation for advancement of engineering research.

Elihu Thomson was born in 1853 at Manchester, England. He invented and designed the Thomson-Houston arc-lighting system, and was a founder of the Thomson-Houston Company. Since 1891, while with the General Electric Company, he has developed the resistance welding art, and has done much original work in optical construction, photography, special chemical problems, steam turbine and internal com-

bustion engines. He is an honorary member of the Institution of Electrical Engineers of Great Britain and was president of the American Institute of Electrical Engineers in 1889-90. He was awarded the first Edison Medal in 1909.

International Bituminous Coal Conference Will Meet Nov. 19

The Carnegie Institute of Technology has announced the second International Conference on Bituminous Coal, which will be held under its auspices in Pittsburgh Nov. 19 to 24.

Upon his return from Europe Dr. Thomas S. Baker, president of the Institute, expressed the opinion that the second conference will be much larger in scope and importance than the first, that the number of delegates from foreign countries will be considerably in excess of that at the 1926 meeting, when 13 different nations were represented. The purpose of the congress is similar to the one held in 1926 and will present the results of recent studies of coal that have to do with improved methods of utilization and combustion. The program will include the discussion of low-temperature distillation, high-temperature distillation, coal-tar products, power, smokeless fuel, complete gasification of coal, hydrogenation, pulverized fuel and its new applications, ard fixation of nitrogen.

Between 60 and 70 scientists and fuel technologists in eleven different countries have tentatively accepted invitations to speak at the second conference. These include about forty Europeans whom Doctor Baker personally invited while making his recent visit in Europe. Among the American engineers and scientists who have accepted an invitation to present papers are the following:

Charles J. Brand, the National Fertilizer Association; H. A. Brassert, consulting engineer, Chicago; Prof. A. G. Christie, Johns Hopkins University; Prof. Harry A. Curtis, Yale University; W. A. Darrah, president, Continental Industrial Engineers; Howard N. Eavenson, consulting engineer, Pittsburgh; Gustav Egloff, Universal Oil Products Company, Chicago; F. C. Green, Old Ben Coal Corporation, Chicago; Prof. E. C. Jeffrey, Harvard University; Louis C. Jones, president, Nitrogen Engineering Corporation; C. F. Kettering, General Motors Corporation; Dr. Arthur D. Little, consulting engineer, Boston; Dr. H. C. Parmelee, editor *Chemical and Metallurgical Engineering;* Prof. S. W. Parr, University of Illinois, president of the American Chemical Society; Dr. F. W. Sperr, Koppers Company, Pittsburgh, Mellon Institute; Prof. Hugh S. Taylor, Princeton University; Dr. R. Thiessen, Bureau of Mines, Pittsburgh; F. G. Tryon, Bureau of Mines, Washington, D. C.; Prof. Alfred H. White, University of Michigan.

The secretary of the Second International Conference on Bituminous Coal is Prof. Sumner B. Ely, Carnegie Institute of Technology.

San Francisquito Power Plant Back in Operation

The first unit of Los Angeles' San Francisquito power plant No. 2, destroyed by the St. Francis dam flood waters on March 13, was placed back in operation recently by the Municipal Bureau of Power and Light after three months of continuous night and day work.

It was pointed out by Chief Electrical Engineer E. F. Scattergood that the reconstruction of power plant No. 2 necessitated practically the construction of an entirely new plant.

A new speed record in this sort of construction work is believed to have been established, it was said, as it was at first estimated that at least four months would be consumed before the first unit of the plant could be placed back in service.

OBITUARY

WILLIAM E. LESTER, chairman of the Denver Section of the American Society of Mechanical Engineers, died June 17 while in his 42d year. Mr. Lester was connected with the Vulcan Iron Works for thirteen years.

HERBERT LLOYD of Bryn Mawr, president of the Electric Storage Battery Company, bank director and clubman, died yesterday following a long illness. He was in his 67th year.

Born in Wales, Mr. Lloyd came to this country to take graduate work in chemistry. Forty years ago he took charge of the laboratory of the Welsbach Light Company and later had a similar position with the United Gas Improvement Company. He had been head of the storage battery concern about twenty years.

PERSONALS

W. A. PIKE, Marshalltown, Iowa, was recently elected president of the local chapter of the National Association of Power Engineers. At the same meeting Dale Hicks was elected vice-president; Perry Sexton, corresponding secretary; C. D. Peterson, secretary; and E. F. Mack, trustee.

CLARENCE PALMER, secretary of the Burt Manufacturing Company, Akron, Ohio, has been selected to represent America in the International Balloon Race to be held this year in Detroit.

FRANCIS A. EMMONS, sales and advertising manager of Foote Bros. Gear & Machine Co. of Chicago, was elected president of the Engineering Advertisers Association of Chicago, at the annual meeting of the association held at the Palmer House, June 4.

LEROY MILLER, of Evansville, Ind., was elected president of the Indiana Chapter of the National Association of Power Engineers at the convention held in Indianapolis recently. Other officers elected were: C. D. Wilgus, of Terre Haute, vice-president; F. L. Clifford, of Kokomo, secretary; E. G. Heeger, of Evansville, treasurer; George F. Spangler, of Indianapolis, conductor; Charles D. Humble, of Terre Haute, doorkeeper. The meeting next year will be held at Terre Haute, Ind.

H. S. PAHREN has joined the Kansas City district office of the Elliott Company, as sales engineer, and C. H. Russell has joined the Baltimore district office of the same company.

DAVID C. JOHNSON was elected president of the New York Steam Corporation at a meeting of the board of directors held on July 2. Mr. Johnson succeeds James D. Hurd, who died recently. There was no other change made in the officers of the organization.

FRANCIS R. WELLER, Mills Building, Washington, D. C., has incorporated his organization, taking into the company his employees, many of whom have been associated with him for long periods of time. Mr. Weller's organization

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.40@$2.60
Kanawha.....	Columbus.....	1.25@ 1.60
Smokeless.....	Cincinnati.....	1.75@ 2.25
Smokeless.....	Chicago.....	1.65@ 2.00
S. E. Kentucky...	Chicago.....	1.25@ 1.50
Steam.....	Pittsburgh.....	1.40@ 1.80
Gas Slack.....	Pittsburgh.....	1.10@ 1.25
Big Seam.....	Birmingham....	1.40@ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—July 5, f.o.b. Bayonne, N. J.: 28@34 deg., Baumé, industrial use, tank-car lots, 5c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis—June 27, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.45 per bbl.; 26@28 deg., $1.50 per bbl.; 28@30 deg., $1.55 per bbl.; 30@32 deg., $1.60 per bbl.; 32@36 deg., gas oil, 4.15c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—June 18, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—July 3, 26@30 deg., $2.07 per bbl.; 13@19 deg., $1.22 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.17 per bbl.

Cincinnati—June 26, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—June 22, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 75c.@80c. per bbl.; 26@30 deg., 80c. per bbl.; 30@32 deg., $1.02½@$1.05 per bbl.

Boston—June 25, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—July 2, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

has specialized in the design, construction and operation of public utilities. Among the utility companies managed at the present time are: The Allied Utilities Company, with subsidiary companies, the North Alabama Utilities Company, the Consumers Gas Utility Company, and the Mississippi Gas Company.

Business Notes

The Brown Instrument Company of Philadelphia, has plans under way for a new addition to its plant. The new structure will be 60 ft long by 44 ft. deep and two stories in height and will provide research facilities commensurate with the needs imposed by the expansion of the company's interests.

The Atlas Conveyor Company announces that A. J. Forschner has become associated with the company as vice-president.

The Chisholm-Moore Manufacturing Company, Cleveland, which recently became a subsidiary of the Columbus McKinnon Chain Company, Tonawanda, New York, will hereafter be known as Chisholm-Moore Hoist Corporation (Division of Columbus McKinnon Chain Co.)

Trade Catalogs

Automatic Stations—A new 32-page bulletin, No. GEA-90C, of the General Electric Company, Schenectady, N. Y., lists all the automatic-station installations made by that company up to January first of this year. These installations include both automatic substations and hydro-electric plants.

Magnetic Switches—Type CR 7006-D31 magnetic switch of the General Electric Company, Schenectady, N. Y., is described in that company's bulletin GEA-869. These switches are for use with alternating-current motors and are provided with temperature overload protection and under-voltage release.

Magnetic Clutches—The Magnetic Manufacturing Company, Milwaukee, Wis., has issued Bulletin No. 72, descriptive of high-duty magnetic clutches of standard and special design, including horsepower ratings and dimensions.

Insulation — In bulletin No. 141, "Insulation of Breechings and Stacks," published by Celite Products Company, 1320 South Hope St., Los Angeles, Calif., are given specifications covering the lining of stacks and breechings on the inside of the steel with Sil-O-Cel Standard Brick. Drawings are included showing the method of lining breechings and stacks.

Water-Level Recorders and Indicators—Bulletin "Telaurec," recently published by Julien P. Friez & Sons, Baltimore, Md., is descriptive of the Au water-level recorders and indicators for recording and remote indications of water levels at power plants and water works. By the use of self-synchronizing motors in this apparatus, water levels can be transmitted almost any distance.

Absorbed Oils and Lubricators—The use of semi-fluid or absorbed oils for lubricating purposes has been extended owing to the introduction of improved lubricating devices. In a pamphlet just published by E. F. Houghton & Co., Philadelphia, Pa., the Gun-Fil lubricator is described, and the proper devices for the various absorbed oils and rates of feed are listed.

Ground-Resistance Tester—Technical Bulletin 1185, recently issued by James G. Biddle, 1211 Arch St., Philadelphia, Pa., contains 24 pages on the measurement of the resistance to earth of ground connections. This publication is not, in the general sense of the word, a catalog, but a book of instruction on measuring ground resistance.

New Plant Construction

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Ala., Gadsden — A. Rich, Printop Hotel, plans the construction of a 10 story hotel including steam heating and refrigeration systems, elevators, etc. D. O. Whilldin, 523 North 21st St., is architect.

Ark., Little Rock—Farrell Hotel Co., awarded contract for a 10 story hotel at Seventh and Scott Sts. to W. F. Ault, Moore Turner Bldg. Estimated cost $1,000,000.

Calif., Los Angeles—Southern California Edison Co., 306 West Third St., is having plans prepared for a 12 story office building on Grand Ave. Estimated cost $2,000,000. Allison & Allison, Hibernian Bldg., are architects.

Calif., Los Angeles—A. D. Van Vranken Co., 756 South Spring St., is having preliminary plans prepared for a 10 story office, stores and loft building including steam heating system, elevators, etc. at 12th St. and Grand Ave. Estimated cost $1,000,000. Morgan, Walls & Clements, 1135 Van Nuys Bldg., are architects.

Calif., Oakland—Interests represented by M. B. Reed, 1736 Franklin St., are having plans prepared for the construction of a 9 story medical office building at 34th St. and Broadway. Estimated cost $900,000. E. W. Cannon, Ray Bldg., is architect.

Conn., Stamford—Shippan Point Hotel, c/o C. S. Adams, 2038 Spruce St., Philadelphia, Pa., Archt., is having plans prepared for a 16 story hotel including swimming pool here.

Fla., Miami—Clyde Steamship Co., Pier 36 North River, New York, N. Y., is having sketches made for the construction of first unit of cold storage plant on Pier 2 here. Estimated cost $50,000.

Ill., Chicago — Horders Inc., 236 West Lake St., awarded general contract for the construction of a 7 story office and warehouse at Jefferson and Quincy Sts. to George Thomson & Sons Co., 30 North La Salle St. Estimated cost $600,000.

Ill., Chicago—Michigan-Grand Building Corp., c/o Thielbar & Fugard, 219 East Superior St., awarded contract for a 16 story store and office building to Dilks Construction Co., 160 North La Salle St.

Ill., Chicago—A. S. Alschuler Inc., 28 East Jackson Blvd., Archt., is receiving bids for a 10 story printing plant at 318-328 South Jefferson St. for J. T. Igoe, Van Buren and Jefferson St. Estimated cost $1,000,000.

Ill., Chicago—Syndicate, c/o Hooper & Janusch, 879 North State St., Archts., is having plans prepared for a 20 story apartment building at 1420 Lake Shore Drive. Estimated cost $3,000,000.

Ind., Hammond—L. E. Deutsch, Gary, is receiving bids for a 6 story hotel including steam heating system, elevators, etc. at Clinton and Hohman Sts. here. Estimated cost $500,000. L. H. Wariner, Gary, is architect.

Ind., Indianapolis—Chesapeake Realty Co., c/o Bennett Kay, 738 Lemcke Bldg., Archt., awarded general contract for a 12 story hotel at Illinois and Chesapeake Sts. to S. & J. Falendar, c/o architect. Estimated cost $500,000. Steam heating and ventilation systems, elevators, etc. will be installed.

Massachusetts — Ice Utilities Inc., c/o York Ice Machinery Corp., 200 Causeway St., Boston, Engr., will soon receive bids for the construction of an ice plant on Lowell St., Fall River, also awarded contract for an ice plant at Chelsea to Marden & Orlando, 46 Cornhill, Boston. Estimated cost $100,000 and $50,000 respectively.

Mass., Stoughton—City, F. I. Capen, Chn. of Bd. of Selectmen, plans the construction of central heating plant. Engineer not selected.

Mich., Detroit—A. G. Wilson, c/o Fidelity Trust Co., 147 West Congress St., awarded contract for a 6 to 10 story theater building on Madison Ave. to Bryant & Detwiler, 2336 Dime Bank Bldg. Estimated cost $1,500,000. Steam heating and ventilation systems, boilers, elevators, etc. will be installed.

Mich., Detroit—Womens Hospital & Infants Home, F. H. Holt, 443 East Forest Ave., awarded contract for a 5 story hospital on East Hancock Ave. Estimated cost $1,000,000. Steam heating, ventilation and refrigeration systems, boilers, elevators, etc. will be installed.

Minn., Minneapolis—W. B. Foshay Co., 9th St. and 2nd Ave. S., awarded contract for a 30 story office building at 9th St. between Marquette and Second Aves. to National Contracting Co., 311 Metropolitan Bank Bldg. Estimated cost $2,500,000. Steam heating system, etc. will be installed.

Mo., Kansas City—Swope Estate, c/o C. A. Smith, 800 Finance Bldg., Archt., is having plans prepared for a 16 story office building at 11th St. and Grand Ave. Estimated cost $1,500,000. G. E. McIntyre, 800 Finance Bldg., is engineer.

Mo., Perryville—City will soon award contract for waterworks improvements including filtration plant, distribution system, pumping equipment, tank on tower, etc. Estimated cost $120,000. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, is engineer.

Mo., St. Louis—Meyer Finkelstein, et al., c/o 800 Washington Ave., plans the construction of a 15 story apartment building including steam heating system, etc., at Lindell St. and Taylor Ave. Estimated cost $1,250,000.

Mo., St. Louis—Coronado Hotel Co., c/o Preston J. Bradshaw, 718 Locust St., Archt., will build a 14 story hotel and apartment building including swimming pool, etc. at Lindell St. and Spring Ave. Estimated cost $2,500,000. Work will be done by separate contracts.

Mo., St. Louis—Hotel Investment Co., G. W. Hunter, Railway Exchange Bldg., awarded contract for a 15 story hotel at Market and Eighth Sts. to Kopman Construction Co., 4525 Lindell Blvd. Estimated cost $1,300,000. Steam heating system, elevators, etc. will be installed.

N. J., Asbury Park—Mayfair Theatre Corp., awarded contract for the construction of a 30 x 60 ft. boiler room to Edgewater Construction Co., 156 East 42nd St., New York, N. Y. Estimated cost $40,000.

N. J., Belleville—Bd. of Chosen Freeholders, Hall of Records Bldg., Newark, will soon award contract for an addition to emergency hospital, power house, etc. at Essex County Hospital here. Estimated cost $150,000. Sutton, Sutton & Calkins, 402 Broad St., Newark, are architects. Runyon & Carey, 31 Fulton St., Newark, are engineers.

N. J., Newark—W. E. Lehman, 972 Broad St., Archt., is receiving bids for a 15 story hotel including steam heating and ventilation systems, boilers, elevators, etc. at Broad and Hill Sts. for Majestic Holding Corp., c/o architect. Estimated cost $2,000,000.

N. Y., Brooklyn—Brooklyn Eye & Ear Hospital, awarded contract for the construction of a 6 story hospital at 21-39 Greene Ave. to William Kennedy Co., 215 Montague St. Estimated cost $1,000,000.

N. Y., New York—Greeley Sq. Hotel Co., F. A. Duggan, plans the construction of a hotel at 34th St. and Broadway. Estimated cost $2,000,000. W. D. Smith, c/o owner, is architect.

N. Y., New York — St. Lukes Hospital, Amsterdam Ave. and 113th St., plans the construction of a hospital at Riverside Dr. and 120th St. Estimated cost $2,000,000. Architect not selected.

N. Y., New York—Ten West 11th St. Corp., M. Ginsberg, Pres., will build an apartment building at 10 West 11th St. Estimated cost $1,000,000. Van Wart & Wein, 347 Madison Ave., are architects. Work will be done by separate contracts.

O., Akron—Loew's Theatrical Enterprises, N. Shenk, Pres., 540 Broadway, New York, N. Y., awarded contract for an arcade, store and theatre building at 182 South Main St. to Craig-Curtiss Co., 4614 Prospect Ave., Cleveland. Estimated cost $1,000,000. Steam heating system, etc. will be installed.

O., Cincinnati—The Midland Co., 4 West 7th St., plans the construction of a 10 story apartment building on Johnstone Pl. Estimated cost $1,800,000. Garber & Woodward, 4 West 7th St., are architects.

Pa., Sewickley—Sewickley Valley Hospital, will readvertise for new bids soon for the construction of a 6 story hospital on Blackburn Rd. Estimated cost $750,000 Schmidt, Garden & Ericksen, 104 South Michigan Ave., Chicago, Ill., are architects. Former bids rejected.

Tenn., Memphis—Owner, c/o W. C. Hedrick, 1005 First National Bank Bldg., Ft. Worth, Tex., will soon award contract for a 26 story office building at Madison Ave. and Third Sts. Estimated cost $2,000,000.

Texas — Insull Interests, c/o J. C. Kennedy, Dallas, has been granted permit for the construction of a hydro-electric dam on Devil's River in Val Verde county. Estimated cost $300,000. Private plans.

Tex., Denton—City voted $40,000 bonds for the construction of an ice plant. H. T. Brewster, is city engineer.

Tex., San Antonio — Interstate Amusement Co., K. Hoblitzelle, Dallas, will receive bids until July 20, for superstructure of a 15 story theatre and office building including refrigeration and air cooling systems, etc. at Houston St. between Mavarro and St. Marys Sts., here. Estimated cost $2,250,000. J. Eberson, 212 East Superior St., Chicago, Ill., is architect.

Wis., Milwaukee—Wisconsin Cold Storage Co., is having plans prepared for a cold storage warehouse.

Ont., Hamilton—Royal Hotel & Terminal Syndicate, c/o W. G. Brown, 327 James St. S., Archt., is having plans prepared for a 12 to 14 story hotel, bus terminal, etc. including steam heating system, elevators, etc. at Vine, Merrick and James Sts. Estimated cost $2,000,000. F. G. Engholm, Bloor Bldg., Toronto, is engineer.

Ont., Tecumseh—Deauville Beach Club, c/o Reaume Organization, Ford City, awarded general contract for the construction of a 10 story clubhouse near here to F. R. Patterson Construction Co., McKerchey Bldg., Detroit, Mich. Estimated cost $1,000,000. Steam heating system, elevators, etc. will be installed.

Ont., Toronto — Adelaide-Sheppard Co., Ltd., Central Bldg., awarded contract for a 16 story office building at Adelaide St. W to Simcoe Construction Co., Central Bldg. Estimated cost $1,000,000. Steam heating system, elevators, etc. will be installed.

Ont., Toronto—The Toronto Terminals Ry. Co., New Union Station, awarded contract for an express building at York and Station Sts. to Peter Lyall & Sons Construction Co., New Union Station. Estimated cost $750,000. Steam heating system, elevators, etc. will be installed.

Ont., Toronto—Wellington Building Ltd., c/o Baldwin & Greene, 26 Bloor St. W., Archts., plans the construction of a 12 story office and loft building, including steam-vacuum heating system, elevators, etc., on Wellington St. Estimated cost $500,000.

Sask., Saskatoon—The T. Eaton Co. Ltd, Yonge and Queen Sts., awarded general contract for an 8 story department store to Smith Bros. & Wilson, 1420 8th Ave., Regina. Estimated cost $600,000. Steam heating system, elevators, etc. will be installed.

Equipment Wanted

Boilers—State Electricity Commission of Victoria, Melbourne, Australia, bids until Oct. 31 for water tube boilers with auxiliary and accessory equipment for Yallourn power scheme (spec. £1 1s.) Agent-General for Victoria, Victoria House, Melbourne place, Strand, W.C.2.)

Electric Plant — Engineers Office, War Dept., Washington, D. C., is receiving bids for an automatic electric plant for Intracoastal Canal Quarterboat.

Engine — Quartermaster Corps, Ft. Worden, Wash., will receive bids until July 19, for a Diesel engine and appurtances complete for boats.

Engine, Generator, Etc.—Supervising Architect, Treasury Dept., Wash., D. C., will receive bids until July 19, for a new engine, generator, etc. for power house at National Lepers Home, Carville, La.

Power Plant Equipment—Thomas Birrell & Son, Pinkerton, Ont., prices and catalogs on complete equipment for electric light and power plant completely destroyed by fire. Loss $150,000.

Power Plant Equipment—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will readvertise for bids soon for power plant equipment including two 250 kw. Diesel engine generator sets, motor generator sets, motor driven centrifugal fire, fresh water and oil pumps, water softening equipment, a.c. motors for existing air compressors, ammonia compressors and evaporator pumps, switchboards, etc. at Naval Station, Guantanamo Bay, Cuba. Former bids rejected.

Power Plant Equipment — East Bay Municipal Utility Dist., J. Kimball, Secy., Oakland, Calif., will receive bids until Aug. 17 for hydraulic and electrical equipment for Pordee Power plant, Mokelumne River project.

Pump—E. W. G. Meers, Mayor and Bd. of Alderman, Germantown, Tenn., will receive bids until July 16, for one 50 g.p.m. electric motor driven deep well pump with 3 ph., 60 cycle, 220 v. motor, for proposed waterworks improvements.

Pump and Motor—City of Seminole, Okla., is in the market for a 50 g.p.m. deep well pump and motor.

Pumping Equipment—City of Camden, Tenn., plans to purchase pumping equipment, etc. for proposed waterworks improvements. Estimated cost $37,000.

Pumping Equipment—Town of Newton, N. J., H. D. Masters, Clk., will receive bids until July 16, for sludge pumping equipment, etc. for proposed sewage treatment works.

Pumps—City of Monrovia, Calif., F. A. Dupar, Clk, will receive bids until July 16 for pumps, etc. for Lime and Fifth Ave. reservoirs.

Pumps — Colombian Ministry of Public Works, Bogota, South America, bids until July 15 for six centrifugal pumps with petrol engines.

Pumps, Blowers, Switchboard, Etc. — Springfield Sanitary Dist., D. B. Breese, Pres., Bd. of Trustees, Springfield, Ill., will receive bids until July 25, for centrifugal sump pumps, hot water circulation pumps, air blowers, two synchronous motor driven, seven panel power switchboard, etc. for proposed sewage treatment plant.

Steel Tanks — Colombian Ministry of Public Works, Bogota, South America, bids until July 29 for six steel tanks, capacity 40,000 litres each for water supply.

Sub-Station Equipment, Transformers, Etc.—Windsor Hydro Electric Commission, Hydro Bldg., Windsor, Ont., plans to expend $300,000 for sub-station equipment, transformers, etc.

Transformer Station Equipment — State Electricity Works, Montevideo, South America, bids until Aug. 10 for 20 equipments for transformer stations, indoor type, 6,600/200 v., 50 cycle.

Industrial Projects

Calif., South San Francisco—MACHINE SHOP—Pacific Coast Steel Co., Hunter-Sulin Bldg., plans the construction of an 80 x 1508 ft. machine shop, etc. Estimated cost $600,000. Private plans.

Conn., Norwalk—HAT FACTORY—Sunfast Hats Inc. is preparing plans for a 3 story, 200 x 300 ft. factory on Rowan St. Estimated cost $500,000. Fletcher-Thompson, Inc., 542 Fairfield Ave., Bridgeport, are architects.

Ill., Sterling—BARB WIRE FACTORY—Northwestern Barb Wire Co. awarded contract for a 1 story factory to P. Komman, 506 West 4th St. Estimated cost $100,000.

Ind., Muncie—GEAR FACTORY—Warner Gear Co., awarded general contract for a 2 story factory to A. J. Glaser, 610 Jefferson St., also a 1 story, 150 x 250 ft. machine shop to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $75,000 and $50,000 respectively.

Ia., Clinton—FURNITURE FACTORY—Kelly Manufacturing Co. awarded contract for a 3 story, 82 x 160 ft. factory to W. L. Yokom, Dubuque.

Mich., Pontiac—FOUNDRY, etc.—Oakland Motor Car Co. is having plans prepared for a group of buildings including 1 story, 245 x 260 ft. foundry, 2 story, 60 x 360 ft. service building, 1 story, 160 x 247 ft. core building, 80 x 225 ft. sand storage building, 1 story, 120 x 270 ft. casting cleaning building, etc., at Baldwin and Joslyn Roads. Estimated cost $2,000,000. L. A. Blackburn, c/o owners, is engineer. Architect not announced.

Mo., St. Louis — CUTTING MACHINE FACTORY—Universal Cutter Co., J. B. Gury, Pres., 4657 Scott Ave., will soon receive bids for a 2 story, 120 x 188 ft. factory for the manufacture of electrical cloth-cutting machines at Skinker and Clemens Aves. Estimated cost $60,000. A. H. Norrish, 11 Dartford, Clayton, Mo., Archt.

N. J., Elizabeth—COPPER PRODUCTS FACTORY — American Copper Products Corp., Bayway, awarded contract for a 1 story, 105 x 480 ft. factory at Amboy Ave. and Laurel St., to Wigton Abbott Corp., 705 Park Ave., Plainfield. Estimated cost $80,000.

N. J., Jersey City—PASTEURIZING PLANT—Peek Products Co., c/o C. H. Zeigler, 75 Montgomery St., Archt., is having revised plans prepared for a 2 story, 80 x 180 ft. plant at 14th and 15th Sts. Estimated cost $100,000.

N. Y., Niagara Falls—CARBORUNDUM FACTORY—Carborundum Co., Buffalo Ave., awarded contract for an 81 x 224 ft. factory to Laur & Mack, 1400 College Ave. Estimated cost $225,000.

O., Cleveland — FOUNDRY SUPPLY FACTORY—Federal Foundry Supply Co., R. Ditty, Pres., 2639 East 79th St., is receiving new bids for a 1 story, 90 x 260 ft. factory at East 71st St. and Belt Line R.R. E. A. Weiland & Co., 2725 Prospect Ave., are architects.

O., Cleveland — PACKING PLANT — Hildebrandt Provision Co., C. R. Hildebrandt, Pres., 3620 Clark Ave., will soon award contract for a 2 story, 105 x 127 ft. packing plant. Estimated cost $100,000. Anders & Reimers, Eric Bldg., are architects.

O., Kent — GARMENT MANUFACTURERS FACTORY—I. N. Gross Co., M. E. Reed, 1220 West Third St., Cleveland, awarded contract for a 26 x 58 ft. factory and 26 x 29 ft. boiler house to Super-Built Construction Co., 1836 Euclid Ave. Estimated cost $100,000.

Ont., Toronto—PAPER BAG FACTORY—Kilgours Ltd, 21 Wellington St. W. plans the construction of a 7 story, 100 x 200 ft. factory on Fleet St. Estimated cost $250,000. Architect and engineer not selected.

Ont., Weston—BUILDING PRODUCTS FACTORY—The Arco Co. Ltd., 16 Liberty St., Toronto, is having plans prepared for the construction of a factory here. Estimated cost $150,000 to $200,000. Chapman & Oxley, Northern Ontario Bldg., Toronto, are architects.

Sask., Saskatoon—MOTOR ASSEMBLY PLANT—General Motors of Canada, Oshawa, Ont., is having plans prepared for a 2 story plant here. Estimated cost $150,000. Hutton & Sauter, 6 James St. S., Hamilton, Ont., are architects.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

DECLINES outnumber advances two to one, comparing current prices of power-plant materials and supplies with those in effect at this time last month. Leather belting and lacing continues in the upward movement, started over a month ago, which was due to shortage of raw materials. No. 4 babbitt metal is up ¾c. per lb. at New York warehouses. The important price declines of the month affected the following materials: rubber-covered copper wire, brass-shell sockets, Mazda lamps, rubber-sheet packing, linseed oil, and Japanese white wiping cloths.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket	(net) 68c. per ft.	
Common, 2½-in., cotton, rubber-lined	80c. per ft. list, less	50%

Air—Best grade

¾-in., per ft.	3-ply	$0.36½	4 ply	$0.44

Steam—Discounts from List

First grade 30–10% Second grade 40% Third grade 45%

RUBBER BELTING—List price, 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade 45% Second grade 50%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	30–10%
Heavy	25–5%

RAWHIDE LACING—For cut, best grade, 30–10%; 2nd grade, 50–10%. For laces in sides, best, 55c. per sq.ft.; 2nd, 50c. Semi-tanned, cut, 30–10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@$2.35 per bbl. without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots of 250 to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.17
New York	.15½
Cleveland (*per thousand*)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.11	$0.105	$0.11

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ½-in. dia., list (Apr. 1, 1927) less 50-10% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ¾-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $2.90

Cone-head boiler rivets, ½-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $3.00

*Price is for full packages; broken package lots, $6.50 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	66.50
Commercial genuine, intermediate grade	53.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.25

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.60
Flat or square	3.90	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.
These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.
In addition to the above, standard cutting charges are as follows:
2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2¼ and 2½ in..... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$30.00 (net)	$44.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft.	60%	35%
1,000 to 5,000 ft.	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. Delivery charges, approximately 4 per cent. additional.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
¾	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$17.20
No. 16 cotton reinforced heavy		21.00
No. 18 cotton reinforced light		13.20
No. 16 cotton reinforced light		17.60
No. 18 cotton Canvasite cord		14.60
No. 16 cotton Canvasite cord		16.90
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$72.00	*80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	110.00	*122.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1
REFILLS—				
1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than standard package	22%
Standard package	40%
Discount Without Contract—Renewals:	
Less than standard package	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less than standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.50
0-30 ampere, less than standard package	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.22	....	....	....
60	A 21	.22	....	....	....
100	A 23	.35	....	....	....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$5.75	$8.00	$9.75	$16.00
12	8.80	10.20	12.10	22.00
10	11.90	14.00	16.00	28.90
8	17.50	19.20	20.15	39.50
6	.....	.....	30.00	.....
4	.....	.....	42.00	.....
2	.....	.....	60.00	.....
1	.....	.....	82.00	.....
0	.....	.....	101.00	.....
00	.....	.....	119.00	.....
000	.....	.....	142.00	.....
0000	.....	.....	172.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	¼ In. or Pendant Cap Key	Keyless	Pull	⅜ In. Cap Key	Keyless	Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots	29c. per lb.
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb.
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb.
Soldering paste, 2 oz. cans		$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	30-5%
$50.00 list value or over	35%